Tectonic Evolution of the Izmir-Ankara Suture Zone in Northwest Turkey using Zircon U-Pb Geochronology and Zircon Lu-Hf Isotopic Tracers

By

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B.S., The University of Arizona, 2013

Submitted to the graduate degree program in the Department of Geology and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree Master of Science

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Date Defended: 26 July, 2017

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Abstract

Detrital zircons from the Late Cretaceous Murdunu-Göynük forearc basin and the Paleogene Saricakaya foreland basin; part of the greater Central Sakarya Basin located along the Sakarya Zone of the Western Pontides were analyzed to better understand the closure history of the Tethyan oceans. In northwest Turkey, the Variscan Orogeny is characterized by abundant 350-300 Ma zircon U-Pb ages and minimally to highly evolved εHf values. In εHf vs. age space no distinct trends are apparent, consistent with a north dipping subduction zone that emplaced plutons into a southward growing, heterogeneous accretionary margin. From 300-250 Ma εHf values trend from highly to minimally evolved, interpreted as crust thinning, a result of slab roll-back and rifting of the Intra-Pontide Ocean. The Cimmerian Orogeny is characterized by a decrease in magmatism from 250-230 Ma associated with minimally to moderately evolved εHf evolution, followed by a 230-200 Ma magmatic gap consistent with crustal thickening followed by flat-slab underthrusting of the Karakaya Complex. Zircons with 200-115 Ma U-Pb ages are all but absent, interpreted as a magmatic lull. The Alpine Orogeny in northwest Turkey is characterized by an increase in magmatism from 115-85 Ma, associated with minimally intermediate to moderately evolved εHf evolution of Late Cretaceous Murdunu-Göynük forearc zircons. At 100 Ma, Late Cretaceous zircons only found within Paleogene Saricakaya foreland basin sediments deviate from similar aged εHf evolution in forearc basin sediments and plot in both the juvenile and intermediate domains. Minor zircon U-Pb age peaks and contrasting inter-basinal εHf evolution are interpreted to represent onset of Andean-style subduction along the southern margin of the Sakarya Zone at ~115 Ma followed by 100 Ma initiation of intra-oceanic subduction within the İzmir-Ankara Ocean. Epsilon Hf values from zircons with 85-75 Ma U-Pb ages sampled from forearc basin sediments trend from moderately evolved to moderately

intermediate, interpreted as crustal thinning, a result of slab roll-back along the southern margin of the Sakarya Zone, responsible for final rifting of the Western Black Sea. Foreland basin zircon with U-Pb ages of 85-80 Ma deviate towards highly evolved εHf values. These highly evolved and deviant εHf values are interpreted to represent synchronous melting of the Tavşanli Zone and intra-oceanic slab break-off. A single concordant ~66 Ma pre-collisional zircon grain collected from Late Cretaceous forearc basin flysch located directly beneath a regional unconformity is defined by a moderately evolved εHf value prior to complete absence of young detrital grains and is interpreted to represent incipient collision between the Sakarya and Tavşanli zones followed by total arc shut-off. Syn-collisional tuffs yield minimally evolved εHf values that trend toward minimally intermediate εHf values from 55-50 Ma and from minimally intermediate to highly intermediate from 50-46 Ma, interpreted to represent a second episode of slab break-off followed by crustal thickening, a result of renewed syn-collisional underthrusting.

Acknowledgements

I am deeply thankful for being given the opportunity to study with Professor Micheal Taylor at the University of Kansas. Without his encouragement, guidance, patience, and support this project would not have come to fruition. I am also indebted to my committee members; Andreas Möller, who kindly allowed me to use his analytical facilities and ensured all the data collected at the KU IGL for this project was of the highest quality, Noah McLean who continually worked with me to reduce and interpret data, and Mike Blum who reminded me to look at the rocks. I would also like to thank Alexis Licht for generously sharing his samples and knowledge of various basins in Turkey with me. Professor Doug Walker served to expand my literary geologic knowledge and taught me the basic – yet valuable statistical methods and applications for better understanding my geochemical datasets. University of Arizona Professor George Gehrels also served as an invaluable outlet for assistance with Lu-Hf data interpretation. I would like to thank Jeff Oalmann who graciously took his time to help me run my DZ samples for U-Pb as well as served as a bridge of understanding between the Iolite and ET_Redux data reduction schemes. I am thankful to Ty Tenpenny for taking his time to teach me the various mineral separation procedures as well as Wayne Dickerson for helping with sample preparation. Mark Pecha, Jacob Favela and Chelsi White from Arizona Laserchron were integral pieces to this project and were patient as well as malleable.

I am incredibly grateful for financial support provided by The KU department of Geology as well as K. Christopher Beard and Michael Taylor's NSF INSPIRE grant, which supported me for 24 months. Ultimately none of this would have materialized without the echoes of enthusiasm from my family who constantly remind me there's more to life than just living.

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1. INTRODUCTION

Turkey is the eastern Mediterranean part of the Alpine-Himalayan orogen, which trends east-west from Western Europe through the Middle East and into Eastern Asia for over 8,000 km. The active Alpine-Himalayan orogen is a zone of north-south convergence, which accommodated Carboniferous-Late Cretaceous closure of the Tethyan oceans, and Cenozoic juxtaposition of terranes of Laurasian and Gondwanan affinities (Ketin 1966; Şengör and Yilmaz, 1981; Şengör et al., 1988; Okay and Tüysüz, 1999). The İzmir-Ankara-Erzincan Suture Zone (İAESZ) of central Turkey is approximately east-trending for ~1750 km, representing the closure of Paleotethys as well as the multi-branched Neotethyan oceans along a zone of collision and shortening between the Pontide (Laurasia) and Anatolide-Tauride terranes (Gondwana) (Fig. 1). The Pontides formed during Paleozoic-Mesozoic terrane accretion (e.g., Okay et al., 2002; Okay et al., 2013), similar to the development of the westernmost North American Cordillera (e.g., Coney et al., 1980; Gehrels and Pecha, 2014), which unlike North America, was followed by Early Cenozoic continental collision. This study describes the Carboniferous-Paleogene tectonic evolution of the Sakarya Zone, the southernmost terrane of the Pontides.

Large basins, such as the Central Sakarya Basin (Fig. 1) sample vast swathes of land and often serve as an ideal archive for episodes of arc magmatism over geologic time (Wu et al., 2010). Zircon is ubiquitous in crustal rocks, highly resistant to erosion, re-melting and contains high concentrations of U, Pb and Hf isotopes, making it an ideal mineral for geologic investigations (Hawkesworth and Kemp 2006).

Zircon Laser Ablation – Inductively Coupled Mass Spectrometry (LA-ICPMS) U-Pb geochronology and zircon Laser Ablation – Multicollector – Inductively Coupled Mass Spectrometry (LA-MC-ICPMS) Lu-Hf as a geochemical tracer complement paleomagnetic reconstructions (e.g. Stampfli, 2000; Stampfli and Borel, 2002; Stampfli and Kozur 2006; van Hinsbergen et al., 2016; Maffione et al., 2017), field data based geologic studies (e.g. Şengör and Yilmaz, 1981; Altiner et al., 1991; Yilmaz et al., 1997; Tüysüz 1999; Robertson et al., 2004; Moix et al., 2008) and geophysical imaging (e.g., van Hinsbergen et al., 2010b; Salaün et al., 2012). Samples collected from the Paleogene Saricakaya foreland basin, the Late Cretaceous Murdunu-Göynük forearc basin, and the Orhaniye peripheral basin (Fig. 1) of the Western Pontides, were analyzed for detrital zircon U-Pb and zircon Lu-Hf, which serves as a tested method for testing and refining tectonic models (e.g., Ji et al., 2009; Wu et al., 2010; Pecha et al., 2016) regarding the closure history of the Tethyan oceans in northwest Turkey. Therefore, basin-scale detrital zircon U-Pb coupled with Lu-Hf can guide interpretations of geologic processes such as the isolation or connectivity of terranes and periods of crustal thinning vs. crustal thickening. Interpretations of crustal thinning or crustal thickening based on εHf-age datasets that coincide with major rifting or mountain building events based upon independent datasets, such as field observations, may ultimately be related to evolving subduction zone dynamics, which control terrane accretion as well as the opening and closure of ocean basins.

This study evaluates the Late Cretaceous-Early Paleogene closure of the northern branches of the Neotethyan oceans (i.e. İzmir-Ankara and Intra-Pontide oceans), as well as northwestern Turkey's pre-, syn- and post-collisional history, which remain equivocal (e.g., Pourteau et al., 2015). Figure 2 illustrates the various tectonic models used to describe the mechanisms which facilitated the closure of the İzmir-Ankara Ocean and are as follows: (1) 'stepwise subduction models' describe how multiple north dipping, singularly active and temporally distinct subduction zones facilitated the closure of the İzmir-Ankara Ocean and collision between the Tavşanli and Sakarya zones, where subduction zone jumps were preceded by slab break-off events (Okay et al., 2001; Dilek and Altunkaynak, 2009); (2) 'continuous nappe stacking models' describe how a single north dipping subduction zone located along the southern margin of the Sakarya Zone facilitated the Maastrichtian closure of the İzmir-Ankara Ocean and collision between the Tavşanli and Sakarya zones, where Cenozoic southward sweep of basic magmatism is attributed either slab roll-back (van Hinsbergen et al., 2010b) or lithospheric delamination (Pourteau et al., 2015); (3) 'synchronous subduction models' describe how multiple north dipping subduction zones, which were synchronously active facilitated the closure of the İzmir-Ankara Ocean and collision between the Tavşanli and Sakarya zones, where the southernmost Late Cretaceous subduction zone has been placed within the Afyon Ocean (Shin et al., 2013; Speciale et al., 2014) or within the İzmir-Ankara Ocean.

The above models make predictions that can be tested based on the timing, location, and geochemical fingerprint of magmatic events as well as inception of rift basins and thrust belts, which to a first order are controlled by style of subduction (e.g., slab roll-back vs. flat-slab). In the next section we describe the regional geology of the Pontide and Anatolide-Tauride terranes. Then, we present data collected from the Saricakaya, Murdunu-Göynük, and Orhaniye basins within the western Sakarya Zone (Fig. 1), that bear directly on the predictions of the above models. Finally, we present a model based on detrital zircon U-Pb geochronology and Lu-Hf isotopic tracers, which resolves the timing and mechanism(s) leading to the closure of the Tethyan oceans in northwest Turkey.

2. REGIONAL GEOLOGY

In Turkey, the Strandja Zone, İstanbul Zone, and Sakarya Zone exhibit a pre-Carboniferous Laurasian affinity and are collectively known as the Pontides (Okay and Tüysüz, 1999). The Menderes Massif, Tavşanli Zone, Afyon Zone and Central Anatolian Crystalline Complex exhibit significant yet contrasting metamorphic histories and are collectively known as the Anatolides (Okay and Tüysüz, 1999). South of the Anatolides is the Tauride Block, which is interpreted to be the unmetamorphosed equivalent of the Anatolides (Okay and Tüysüz, 1999). Collectively the Anatolides and Taurides are known as the Anatolide-Tauride Block (ATB) due to their pre-Carboniferous Gondwanan affinity (Fig. 1). A unique and enigmatic feature of the ATB is the presence of regionally distributed sub-horizontal nappe sheets containing ophiolite, mélange, marine and transitional sediment in their hanging-wall (e.g., Okay et al., 1996). In this paper the classical definition of the ATB is adopted (e.g., Şengör & Yilmaz, 1981), where the Anatolides and Taurides are treated as a single terrane, which rifted from Gondwana during the Triassic opening of the Neotethys (e.g., Robertson et al., 2012). These composite blocks – or terranes of Laurasian and Gondwanan affinity are juxtaposed against one another along the İzmir-Ankara-Erzincan Suture Zone (İAESZ), which represents the location where a westward narrowing, Late Paleozoic oceanic embayment between Laurasia and Gondwana, known as the Tethyan Ocean closed (Şengör and Yilmaz, 1981).

Below we provide a brief geologic background of these tectonic units whose geologic histories will serve as important constraints to our conceptual model. We also provide brief descriptions of the Paleogene Saricakaya foreland basin, Murdunu-Göynük Late Cretaceous forearc basin, and the Paleozoic Orhaniye peripheral-forearc basin. More detailed terrane and basin descriptions are located in appendix 1.

2.1 Pontides

The Strandja Zone is located in northwestern Turkey (Fig. 1). The basement of the Strandja Zone consists of felsic gneisses and migmatites intruded by Carboniferous-Permian granitoids emplaced during the Variscan Orogeny (Okay and Tüysüz, 1999). Basement rocks are unconformably overlain by Paleozoic and Early Mesozoic continental units, volcanic rocks, and shallow marine carbonates, all of which were subjected to latest Jurassic-earliest Cretaceous greenschist metamorphism (Okay, 1986; Okay et al., 1996). Paleozoic and Mesozoic sedimentary cover rocks are intruded by Late Cretaceous calc-alkaline andesitic plutons emplaced during the closure of the Vardar Ocean, which culminated by ~115 Ma (Okay et al., 1996).

The İstanbul Zone (Fig. 1) is located along the southwestern lobe of the Black Sea, is approximately 400 km E-W by 70 km N-S (Okay and Tüysüz, 1999), and is juxtaposed against the Sakarya Zone via the Intra-Pontide Suture (e.g., Akbayram et al., 2016). The İstanbul Zone consists of a Cadomian (Pan-African) basement (P. Ustaömer et al., 2005), which is overlain by a transgressive sequence of Ordovician-Carboniferous clastic rocks, resembling similar aged sedimentary packages of the Moesian Platform (Okay et al., 1996). During the Early Devonian-Late Carboniferous (±Permian) Variscan Orogeny (Stampfli, 2000) these sedimentary packages were subject to varying degrees of metamorphism and deformation, which propagated from west to east (Okay and Tüysüz, 1999). Triassic transgressive sediments unconformably overly tectonised Ordovician-Carboniferous units (Okay et al., 1996; Okay and Tüysüz, 1999) and were deformed during the Cimmerian Orogeny. Along the northern margin of the İstanbul Zone, Triassic strata is unconformably overlain by Late Cretaceous extrusive volcanic rocks and cut by their intrusive counterpart (Okay and Tüysüz, 1999) (Fig. 1; inset).

The Sakarya Zone (Fig. 1), described by Okay (1984a) combines Şengör and Yilmaz, (1981)'s Sakarya Continent and the Eastern Pontides. However, in this study, we adopt the latter definition due to the abundant and contrasting Paleozoic-Cenozoic volcanic history of the Eastern Pontides (Fig. 1; inset). The Basement of the Sakarya Zone is characterized by Early Paleozoic passive margin strata, which are metamorphosed, deformed and intruded by Carboniferous ±Devonian granitoids emplaced during the Variscan Orogeny (Okay et al., 1996). The Karakaya Complex is located structurally below the Variscan basement (Okay et al., 2002) and consists of a ca. 3 km thick package of mafic Carboniferous, Permian and Triassic sediments (Okay and Tüysüz, 1999; Ustaömer et al., 2016) that underwent varying degrees of metamorphism during the Late Triassic Cimmerian Orogeny (Okay et al., 2002). During the Early Jurassic, conglomeratic strata was deposited and is overlain by a Middle Jurassic-earliest Late Cretaceous ~2 km thick sequence of limestone (Okay and Tüysüz, 1999). Late Cretaceous-Neogene strata are in contact with this limestone sequence along an angular unconformity and coarsen upward into marine turbidites, lagoonal, deltaic and fluvial deposits with interbedded volcanic horizons.

2.2 Anatolides

The Tavşanli Zone (Okay 1984a) strikes E-W for 250-300 km and has an average N-S width of ~50 km (Fig. 2), whose defining feature is a Late Cretaceous blueschist belt with lesser amounts of Triassic blueschist (Okay et al., 2002), the former a result of intra-oceanic subduction from 90-80 Ma and subsequent high-pressure low-temperature metamorphism (Okay et al., 1998; Sherlock et al., 1999; Sherlock and Kelly, 2002). To the east, the contact between the Tavşanli Zone and the Central Anatolian Crystalline Complex is obscured by Upper Cretaceous-

Middle Eocene sediments of the Orhaniye, Haymana-Polatli, and Tuz Gölü basins (e.g., Nairn et al., 2013; Licht et al., 2017)

The Afyon Zone (Fig. 1) (Okay 1984a), structurally beneath the Tavşanli Zone is characterized by Paleocene Barrovian-type metamorphism and underlain by Pan-African basement mantled by low-grade, Late Paleozoic metamorphosed sediments which fine up section from Carboniferous conglomerates to Permian neritic platform-type sediments. Overlying Mesozoic sediments consist of Triassic-Late Cretaceous turbidites, which grade into sandstone beginning in the Paleocene (Candan et al., 2005).

Cenomanian Ar/Ar apparent cooling ages (ca. ~95 Ma) of metamorphic soles of ophiolitic bodies are juxtaposed over the Tavşanli Zone (Önen and Hall, 1993; Önen 1993), Afyon Zone (Daşçi et al., 2014), and the Taurides (Çelik et al., 2006) (van Hinsbergen et al., 2016). These ophiolitic units are related to obduction of a south-directed thrust sheet along an intra-oceanic subduction zone within the İzmir-Ankara Ocean that was active from the Aptian-Maastrichtian. During Early Paleogene syn-collisional orogenesis, these ophiolites were once more translated southward in the hanging-wall of younger south-directed thrust sheets (e.g., Pourteau et al., 2015).

2.3 Basins

The Central Sakarya Basin (Fig. 1) is the primary basin along the Sakarya Zone (e.g., Okay and Tüysüz, 1999). The northern portion of this basin is known as the Murdunu-Göynük Basin (Fig. 1), which consists primarily of Jurassic marine and Cretaceous shallow marine turbidites to transitional sediments with interbedded volcanic horizons (Altiner et al., 1991).

The Saricakaya Basin is located in the southern portion of the Central Sakarya Basin, due north of the İzmir-Ankara Suture. This basin consists primarily of Paleogene conglomeratic red beds that unconformably overly basement and Early-Middle Mesozoic sediments, interpreted to be deposited within a Paleogene foreland basin, whose best outcrops can be observed in the Sakarya River Valley (Fig. 3). From north to south, 3 principal SE directed thrust can be observed in the main study area: 1) the Northern Söğüt Thrust juxtaposes the Söğüt Granite (~325 Ma; P. Ustaömer et al., 2011), metamorphosed basement units (PcB) and uncomformably overlying Jurassic marine limestone (Jm), Late Cretaceous transitional sediments (Kt) and Paleogene terrigenous sediments (PET), which are folded into a broad syncline structurally above Paleogene Saricakaya foreland basin sediments (PET). These footwall sediments are in turn locally folded into a SE verging overturned syncline; 2) the Southern Söğüt Thrust juxtaposes the footwall of the former thrust structurally above the Permo-Triassic Karakaya Complex (TRkc); and 3) the İzmir-Ankara Suture, which juxtaposes the Permo-Triassic Karakaya Complex (TRkc) structurally above Late Cretaceous accretionary mélange (Km) and is the contact between the Sakarya Zone and the Tavşanli Zone (Fig. 3).

3. METHODS

3.1 Sample Strategy

To understand provenance and timing of deposition within the Murdunu-Göynük Basin, we sampled the first conglomeratic bed above Late Cretaceous turbidites (15G002) as well as an overlying volcanic horizon (15G001) near the town of Göynük (Fig. 3). To understand provenance and timing of deposition within the Saricakaya Basin, we sampled rocks in the hanging-wall of the Söğüt Thrust (i.e., Northern Saricakaya Basin) with known depositional ages of Jurassic (15YP04), Late Cretaceous (15YP13) and Eocene (15YP14). In the footwall of the Söğüt Thrust (i.e., Southern Saricakaya Basin) we sampled rocks with Carboniferous (15YP12) and Eocene (15YP09, 15YP08) depositional ages as well as two tuffaceous units (15YP11, 15YP07), which are stratigraphically below all Cenozoic samples (Fig. 3). A single sample was taken from a metamorphosed Permo-Triassic Sandstone (15KZ01) at the base of the Orhaniye Basin, located within the south pointing horn of the Sakarya Zone east of the Central Sakarya Basin in order to evaluate along strike variability in tectonic setting and provenance prior to the Alpine Orogeny (Figs. 1 & 3).

3.2 Sample Preparation

Zircon grains were separated from whole-rock samples using standard heavy-mineral separation techniques including a bottle jack, chipmunk jaw crusher, disk mill, Gemini table, heavy liquids (Methylene Iodide) and a Frantz™ isodynamic magnetic separator, which serves as a tested method to separate minerals based on their chemical and physical properties (e.g., Sircombe and Stern, 2002). Large zircon aliquots for all 11 samples were reduced to representative splits using a microsplitter up to three times, effectively reducing the samples size by one half with each split. The grains were then randomly handpicked (i.e., grains of all sizes, crystal habits, colors and degree of weathering were indiscriminately chosen) under a binocular microscope, mounted in epoxy and polished to between one half and one third width in order to expose the internal structures of the zircon grains.

3.3 Zircon U-Pb Geochronology

Zircon U-Pb analyses were conducted at The University of Kansas Isotope Geochemistry Laboratory (KU-IGL), using a Thermo Scientific Element II Inductively Coupled Plasma Mass Spectrometer attached to a Photon Machines Analyte.G2 193 nm ArF excimer laser ablation system (LA-ICP-MS). 20 µm circular spots were ablated with the laser at 2.0 J cm^{-2} fluency and 10 Hz repetition rate to depths of ca. 15 µm, where the ablated material was carried to the ICP in He gas. Elemental fractionation, downhole fractionation and calibration drift were corrected by bracketing measurements of unknowns with the GJ1 primary reference material which has a known Thermal Ionization Mass-Spectrometry (TIMS) $^{207}Pb/^{206}Pb$ age of 608.53 ± 0.037 Ma (Jackson et al., 2004). All accepted primary standard analyses during the LA-ICP-MS analyses of this study fell within 2 standard deviations of the published age. As a means to validate the calibration of the GJ1 primary reference material, Plešovice and Fish Canyon Tuff zircons were treated as unknowns (from herein referred to as secondary reference materials) to be compared to their known Chemical Abrasion – Thermal Ionization Mass-Spectrometry (CA-TIMS) $^{207}Pb/^{206}Pb$ age of 337.13 ±0.13 Ma and 28.642 ±0.025 Ma respectively (Sláma et al., 2008; Wotzlaw et al., 2013). Concordant ages were then used to calculate a weighted mean and the Mean Square Weighted Deviation (MSWD). Analytical sessions in which both the Plešovice and Fish Canyon Tuff fell within 2 standard deviations of their true ages and exhibited an MSWD between 0.3 and 2.5 were deemed acceptable and allowed interpretation of true unknowns. All data was reduced using the intercept ET_Redux reduction scheme (McLean et al., 2016).

Complications in data reduction and analysis were common with the Fish Canyon Tuff secondary reference material, likely a result of unobserved inclusions or common lead contamination within fractures of individual grains. Analytical parameters used for all runs can be found in appendix 3.

4. Zircon U-Pb Results

In this section zircon U-Pb data are described from the stratigraphically lowest (oldest) to highest (youngest) sample from the southern Saricakaya Basin, northern Saricakaya Basin, Murdunu-Göynük Basin and the Orhaniye Basin (Fig. 1). Detrital zircon populations are described from youngest to oldest. Figures 4-7 contain concordia and probability density plots (PDP's) of the following results and figure 8 contains PDP's of all samples analyzed in this study organized by their location and depositional setting (i.e., detrital vs. volcanic). Analyses were inspected individually to insure satisfactory data quality. Major deviations in $^{206}Pb/^{238}U$ and $^{206}Pb/^{207}Pb$ ratios deemed not to be a consequence of random and independent data collection resulted in analysis rejection. Analytical uncertainties of standards are provided in appendix 4 and raw data specific to individual samples can be found in appendix 5.

4.1 Southern Saricakaya Basin

Sample 15YP12 was collected from a basement outcrop. 70 individual spots on a total of 70 zircons were ablated, of which 60 analyses were deemed acceptable. Sample 15YP12 yielded a single major age cluster between 312-338 Ma (n=43/60; 72%), with a minor age cluster from 345-360 Ma (n=9; 15%) and single grains analyses from 472-2512 Ma (n=8/60; 13.33%). Of the 43 ages that defined the youngest age cluster 15 were used to calculate a weighted mean of 316.7 ±1.2 Ma, MSWD=1.1, n=15 which is interpreted as the maximum depositional age (Figs. 3,4,8).

Sample 15YP11 was collected from a Paleogene tuffaceous unit. 150 individual spots on a total of 149 individual zircons were ablated, of which 98 were deemed acceptable. Sample 15YP11 yielded a single age cluster from 47.5-55 Ma. Of the 98 ages, 56 concordant analyses were used to calculate a weighted mean of 52.43 ±0.55 Ma, MSWD=0.99, n=56, which we interpret as the maximum depositional age of the unit (Figs. 3,4,8).

Sample 15YP07 was collected from a stratigraphically higher Paleogene tuffaceous unit. 60 individual spots on a total of 60 zircons were ablated, of which 36 analyses were deemed acceptable. Sample 15YP07 yielded a single age cluster from 45.5-52 Ma. Of the 36 analyses, 20 concordant ages were used to calculate a weighted mean of 48.89 ±0.71 Ma, MSWD=1.0, n=20, which we interpret as the maximum depositional age of the unit (Figs. 3,4,8).

Sample 15YP08 was collected from a Paleogene terrigenous sandstone located just below the appearance of granitic clasts. 150 individual spots on a total of 150 individual zircons were ablated, of which 129 analyses were deemed acceptable. Sample 15YP08 yielded a complex age spectrum, with the youngest analyses yielding single Jurassic and Triassic ages (n=2/129; 1.44%). Minor age clusters appear from 275-397.5 Ma (n=21/129; 16.3%), 439-482 Ma (n=11/129; 8.5%), 592-657 Ma (n=26/129; 20.1%), and 698-904 Ma (n=18/129; 13.9%). A more significant zircon age cluster is observed from 943.5-1087 Ma (n=28/129; 21.7%), followed by single U-Pb results from 1320-2600 Ma (n= 17/129; 13.2%) (Figs. 3,4,8).

Sample 15YP09 was collected from a Paleogene terrigenous sandstone containing granitic clasts. 150 individual spots on a total of 149 individual zircons were ablated, of which 137 analyses were deemed acceptable. Sample 15YP09 yielded a complex age spectrum, with minor zircon age clusters observed at 79-89 Ma (n=14/137; 10.2%), 210-258 Ma (n=5/137; 3.6%), 294-364 Ma (n=18/137; 13.1%) and 382-418 Ma (n=22/137; 16%). A major age cluster is observed from 536-711 Ma (n=30/137; 21.9%), followed by minor age clusters from 761-865 Ma (n=7/137; 5.1%) and 917-1145 Ma (n=19/137; 13.9%), single U-Pb results are observed from 1300-3490 Ma (n=17/137; 12.4%) (Figs. 3, 4,8).

4.2 Northern Saricakaya Basin

Sample 15YP04 was collected from a Jurassic sandstone. 137 individual spots on 137 individual zircons were ablated, of which 133 analyses were deemed acceptable. Sample 15YP04 yielded a single major age cluster from 312-352 Ma (n=113/133; 85.6%), with a tail consisting of three analyses with ages from 376-382.5 Ma (n=3/133; 2.3%) and a broad minor age peak from 544-697 Ma (n=13/133; 9.8%). Single zircon analyses yielded ages of 1050-3375 Ma (n=3/133; 2.25%) (Figs. 3,5,8).

Sample 15YP13 was collected from a Late Cretaceous volcanogenic unit. 127 spots on 127 individual zircons were ablated, of which 114 analyses were deemed acceptable. A single concordant analysis is observed at 66 Ma (n=1/114; 0.88%), followed by a major age cluster from 78-92.5 Ma (n=90/114; 80%), a minor age cluster from 100-115 Ma (n=6/114; 5.3%) and sporadic single analyses with ages ranging from 167-2464 Ma (n=16/114; 14%). Of the 90 youngest analyses, 8 were used to calculate a weighted mean of 79.04 ±0.46 Ma, MSWD=0.83, which is a conservative interpretation of the units maximum depositional age due to the presence of a single ~66 Ma concordant analysis (Figs. 3,5,8).

Sample 15YP14 was collected from a Paleogene terrigenous sandstone. 140 individual spots on a total of 139 zircons were ablated, of which 130 analyses were deemed acceptable. Sample 15YP14 yielded a complex zircon age spectrum with a major age cluster from 75.5-86.5 Ma (n=33/130; 25.4%), a minor age cluster from 99.5-106.7 Ma (n=5/130; 3.8%), and a subsequent major and minor age cluster from 308-347.5 Ma (n=28/130; 21.5%) and 365.5-418 Ma (n=16/130; 12.3%). Minor age clusters were also observed from 446-475 Ma (n=8/130; 6.1%), 540-657 Ma (n=18/130; 13.8 %), 899-1128 Ma (n=8/130; 6.1 %), and 1865.5-2029.5 Ma (n=7/130; 5.4 %). Single zircon analyses from 2475-3304 Ma (n=3/130; 2.4%) are also observed (Figs. 3,5,8).

4.3 Murdunu-Göynük Basin

Sample 15G001 was collected from a Late Cretaceous tuffaceous unit. 96 individual spots on a total of 83 zircons were ablated, of which 91 analyses were deemed acceptable. Analyses from sample 15G001 consistently clustered between 72 and 84 Ma. Of the 91 acceptable analyses, 50 were used to calculate a weighted mean of 77.8 ±1.2 Ma, MSWD=0.47, n=50 (Figs. 3,6,8).

Sample 15G002 was collected from a Late Cretaceous conglomeratic unit. 147 spots on 111 individual zircons were ablated, of which 130 analyses were deemed acceptable. Sample 15G002 yielded major age clusters from 67-107.5 Ma (n=55/130; 42.6%) and 298.5-342.5 Ma (n=34/130; 25.75%). Minor age clusters appear at 363-461 Ma (n=10/130; 7.57%), 565-630 Ma (n=8/130; 6%), 935-997 Ma (n=5/130; 3.8%), and 1792-1999 Ma (n=6/130; 4.5%). Of the 55 analyses that define the youngest age peak, 15 ages were used to calculate a weighted mean of 76.05 ±0.93 Ma, MSWD= 1.0, n=15, which we interpret as the units maximum depositional age (Figs. 3,6,8).

4.4 Orhaniye Basin

Sample 15KZ01 was collected from a metamorphosed Permo-Triassic sandstone. 100 spots on 95 individual zircons were ablated of which 93 analyses were deemed acceptable. Sample 15KZ01 yields a major Permo-Triassic age cluster from 225-270 Ma (n=42/93; 45.2%) and a smaller major age cluster in the Carboniferous from 305-405 Ma (n=37/93; 39.8%). A minor age peak is observed from 635-775 Ma (n=7/93; 7.5%). Single analyses have ages between 1040-2725 Ma (n=7/93; 7.5%). Of the 42 analyses that define the youngest age peak, 36 were used to calculate a weighted mean of 250.6 ±4.2 Ma, MSWD= 0.99, n=36, which we interpret as the units maximum depositional age (Figs. 3,7,8).

5. Lu-Hf Isotopic Tracers

All zircon U-Pb samples were analyzed for Hf isotopes at The University of Arizona's geochronology facility; Arizona LaserChron (ALC). For samples with complex zircon age distributions approximately 50 zircons, representative of the samples minor and major age clusters were analyzed (e.g., Gehrels and Pecha, 2014). Zircons with concordant ages of interest were pre-screened using Cathodoluminescence (CL) imagery in order to select U-Pb spots located exclusively on zircon rims or cores. Hf isotopic analysis was achieved using a 50 µm beam diameter placed over the original U-Pb spot in order to ensure initial $^{176}Hf/^{177}Hf$ ratios being measured were representative of the isotopic composition measured during U-Pb analysis. To accommodate the analysis of smaller grains, the beam diameter was reduced to 40 µm. Data was collected using a Nu Plasma HR ICP-MS, coupled to a Photon Machines Analyte G2 laser equipped with a LelEX cell. The ICP-MS is outfitted with 12 fixed Faraday detectors equipped with $3x10^{11}$ Ω resistors, 10 of which measure masses ^{171}Yb through ^{180}Hf. This configuration provides an enhanced signal to noise ratio for low intensity ion beams generated by laser ablation. The instrument has a factor of ~two improvement in the signal to noise ratio compared to standard $1x10^{11}$ Ω resistors, however is limited to a maximum signal intensity of 3.4 V on each Faraday collector. Hf-Yb-Lu solutions are introduced in Ar carrier gas via a Nu DSN-100 desolvating nebulizer in order to calibrate the machine prior to the analysis of unknonwns. Minerals are analyzed via laser ablation, with He carrier gas mixed with Ar make-up gas before introduction to the plasma torch (See Arizona LaserChron 'Hf analytical methods description' webpage). Appendix 6 contains all Hf reference material analyses (organized in a single plot).

Age vs. εHf plots are commonly used to display Hf data, where: $\varepsilon Hf_{(0)}=\{[(^{176}Hf/^{177}Hf)^0_{sample}\ /\ (^{176}Hf/^{177}Hf)^0_{CHUR}]\ -1\}\ x\ 10^4$ & $\varepsilon Hf_{(t)}=\{[(^{176}Hf/^{177}Hf)^t_{sample}$ -

$(^{176}Hf/^{177}Hf)^t_{CHUR}$ / $(^{176}Hf/^{177}Hf)^t_{CHUR}]$ -1} x 10^4 (e.g., Vervoort, 2014). The $\varepsilon Hf_{(t)}$ notation indicates the $^{176}Hf/^{177}Hf$ ratio at the time of crystallization based upon the evolution of the chondritic uniform reservoir (CHUR) at that time. Measurement precision is expressed as a 2σ average uncertainty. Furthermore external precision is approximately ±2 ε units, as indicated by the distribution of reference material analyses (e.g., Bahlburg et al., 2009), with a predicted ~3.1 epsilon unit reproducibility based on 2σ uncertainties. We define εHf arrays according to Bahlburg et al., (2011), who define εHf values within 5 units of the depleted mantle (DM) as juvenile, values between 5 and 12 ε units below the depleted mantle as intermediate and anything > 12 ε units below the depleted mantle as evolved.

6. Lu-Hf Results

In the following section samples are described from oldest to youngest (i.e., Mesozoic and Cenozoic) irrespective of their present geographic location. Age clusters within single samples are also described from oldest to youngest in terms of positive εHf vs. age trends (εHf pull-ups; increase in εHf over time), negative εHf vs. age trends (εHf pull-downs; decrease in εHf over time), and vertical εHf vs. age trends (εHf vertical arrays; no trend), where applicable. Positive εHf vs. age trends (εHf pull-ups) are significant of melting of a juvenile reservoir and are often interpreted to represent crustal thinning. Negative εHf vs. age trends (εHf pull-downs) are significant of melting of an intermediate or evolved reservoir and are often interpreted as crustal thickening or melting of ancient (evolved) crust. Vertical εHf vs. age trends (εHf vertical arrays) are significant of melting of a heterogeneous reservoir and are often interpreted to be a result of melts mixing with a highly age-variable upper plate (e.g., Ji et al., 2009). Results specific to individual spots are located in appendix 7.

Sample 15YP12 contains a single major zircon U-Pb age cluster and several minor age clusters, which evolve from [-6, -10] εHf units from 360-345 Ma followed by εHf evolution from [-10, -2.5] units from 345-310 Ma interpreted as a small εHf pull-down followed by an εHf pull-up (Fig. 9).

Sample 15KZ01 contains two major zircon age clusters, which evolve from [-7.5, -2.5] from 365-310 Ma and from [2.5, -2.5] from 260-220 Ma, interpreted as an εHf pull-up followed by a pull-down. A single zircon plots at -15 εHf units and is likely sourced from a different arc (Fig. 9).

Sample 15YP04 shows a single major cluster of zircon ages from 345-320 Ma which are characterized by εHf values from [-10,-2] with a vertical εHf-age trend, interpreted as a vertical array (Fig. 9).

Sample 15YP13 exhibits a dominant Late Cretaceous cluster of zircon ages and many older isolated single analyses. Older analyses plot between [-6, 8] εHf units and are too disparate to identify meaningful trends. Zircons with 115-90 Ma crystallization ages exhibit εHf values that evolve from [8, 2], followed by 80-75 Ma zircons with εHf values that evolve from [-5, 5]. A single concordant zircon U-Pb age at ~66 Ma is defined by an εHf value of [-2.5] (Fig. 9).

Sample 15G001 was collected from a Late Cretaceous tuff. A single zircon age cluster is observed from 84-75 Ma exhibiting εHf values between [7.5, 0] (Fig. 9).

Sample 15G002 contains a cluster of zircon ages from 350-300 Ma which exhibit εHf values of [0, -7.5], from 300-230 Ma εHf values range from [-7.5, 2.5] followed by a decrease in εHf values to [0] from 230-200 Ma. Zircons with crystallization ages from 85-75 Ma exhibit εHf values that range from [5, -7] (Fig. 9).

Sample 15YP11 was collected from an Eocene Tuff and exhibits a single zircon age cluster from 55-47 Ma, which exhibit εHf values from [2.5, 8]. Sample 15YP07 was collected from a stratigraphically higher Eocene tuff whose zircon ages clustered between 52-46 Ma and exhibit εHf values from [4, 7.5] (Fig. 10).

Sample 15YP08 was collected from Eocene terrestrial sandstone and exhibits a complex zircon age distribution. Four zircons with crystallization ages between 350-330 Ma plot from [10, -6] εHf units. Two zircons with crystallization ages of ~275 and ~245 Ma exhibit εHf values of [-2] and [-3.5] (Fig. 10).

Sample 15YP09 collected from a stratigraphically higher Eocene terrestrial sandstone and also exhibits a complex zircon age distribution. Three zircons with crystallization ages ranging from 315-210 Ma exhibit εHf values that range from [-5, 0]. Zircons with crystallization ages between 90-80 Ma exhibit εHf values of [-12, -5] (Fig. 10).

Sample 15YP14 was collected from an Eocene terrestrial sandstone and exhibits a complex zircon age distribution. Five zircons with crystallization ages between 350-300 Ma exhibit εHf values of [2, -2.5]. Three zircons with crystallization ages from 270-250 Ma exhibit εHf values of [5, -5]. At 100 Ma three zircons with overlapping crystallization ages exhibit εHf values of [5, 12.5], from 90-75 Ma zircons exhibit εHf values of [-10, 6] (Fig. 10).

7. CUMULATIVE PLOTS

Under the assumption that zircons within detrital samples from the southern Saricakaya Basin, the northern Saricakaya Basin, the Murdunu-Göynük Basin, and the Orhaniye Basin formed by similar orogenic processes (i.e., Variscan, Cimmerian and Alpine orogenies), cumulative probability density and εHf plots are constructed to describe the onset and duration of arc magmatism, as well as characterize changes in the contributing melt reservoir (i.e., crustal vs. mantle sources) during the closure of the Tethyan oceans (Fig. 11).

7.1 Cumulative Zircon PDP

Crystallization ages of 518/812 detrital zircons (64%) fall between 0-416 Ma, which brackets the orogenic events of interest. The Variscan Orogeny occurred from the Devonian-Carboniferous and yields 346/518 (66.8%) analyses, which are characterized by a minor Devonian (59/346; 17%) and major Carboniferous (287/346; 83%) age clusters. Permian dates are characterized by an increase in magmatism (30/518; 6%) prior to the Cimmerian Orogeny. In this study we loosely bracket the Cimmerian Orogeny as a Triassic event, however strictly speaking this orogeny lasted from 220-200 Ma (Okay et al., 2002); using this latter definition our samples only yield 3/518 analyses (0.6%). A broader Triassic definition however, (250-200 Ma) yields 34/518 grains (6.6%). From 200-115 Ma, a single analysis is observed (1/518; 0.2%). Zircons from the Alpine Orogeny yielded of 107/518 analyses (20.7%), which defines an increase in the abundance of zircons from 120-90 Ma (11/107; 10.3%), followed by a major age cluster (95/107; 88.8%) from 90-70 Ma. A single concordant U-Pb age is observed at ~66 Ma (1/107; 0.9%) (Fig. 11).

7.2 Cumulative Lu-Hf Plot

The shapes and colors of data points are based on their tectonic setting (Orange: Cenozoic Foreland Basin, Green: Late Mesozoic Forearc Basin, Blue: Middle Mesozoic Passive Margin, Purple: Early Mesozoic-Late Paleozoic Forearc Basin) and their lithology (Circle: Detrital, Triangle: Volcanic, Diamond: Basement). From 400-340 Ma an evolved horizontal trend at -7.5 ε units is observed, detrital grains in Cenozoic sediments exhibit observable deviations from this trend between 380-360 Ma. From 340-300 Ma vertical arrays are observed, followed by an εHf pull-up, which remains in the evolved regime from 300-250 Ma. From 120-80 Ma, an intermediate to evolved εHf pull-down is observed. Grains from Cenozoic strata with overlapping crystallization ages exhibit similar trends, however deviate towards more juvenile εHf values at 100 Ma and more evolved εHf values between 85-80 Ma. From 80-75 Ma, εHf values from Cretaceous and Eocene strata exhibit a sharp pull-up from evolved to intermediate. A single concordant detrital zircon plots in the evolved regime at ca. 66 Ma. Volcanogenic sediments with crystallization ages ranging from 55-45 Ma plot in the intermediate εHf domains and exhibit a slight pull-up from 55-50 Ma followed by a minor pull-down from 50-45 Ma (Fig. 11).

8. SYNTHESIS

8.1 350-250 Ma

The Variscan Orogeny resulted in abundant calc-alkaline plutonism within the Sakarya Zone from 350-300 Ma, characterized by evolved εHf pull-ups and vertical arrays (Fig. 12 A). Zircon U-Pb and Hf data are consistent with a north dipping subduction zone along the southern margin of the Sakarya Zone (Fig. 12 B). Evolved εHf pull-ups and vertical arrays (Fig. 12 A) are interpreted to be either a result of granitoid emplacement into a heterogeneous basement consisting of metamorphosed marginal sediments of Gondwanan affinity; a mixture of accretionary sediments, exotic micro-terranes, and Devonian plutons, or the intrinsic nature of the detrital zircons which sampled a long lived cordillera (i.e., Chapman et al., 2017). Variscan shortening and regional metamorphism is also observed in the İstanbul Zone, however to a lesser degree (Okay and Tüysüz, 1999), suggesting inter-terrane proximity. An εHf pull-up from 300-250 Ma is observed in samples located within the Saricakaya and Murdunu-Göynük basins (Fig. 12 A). This weakly defined εHf pull-up may be significant of lithospheric and crustal thinning driven by slab roll-back, which resulted in the opening of the Intra-Pontide Ocean (Fig. 12 B).

8.2 250-200 Ma

Sample 15KZ01, collected from the Orhaniye Basin is spatially and chronologically unique to this study in that Cretaceous and older samples from near and around the Sakarya River Valley (Fig. 3) analyzed in this study do not yield similar zircon age dates. Triassic zircon U-Pb age clusters exhibit an εHf pull-down from 250-230 Ma, followed by a magmatic gap from 220-200 Ma (Fig. 12 A), interpreted as crustal thickening and flat-slab tectonism (Fig. 12 C), which resulted in arc shut-down related to underthrusting of the Karakaya Complex (Okay et al., 2002). The Triassic magmatic gap (250-200 Ma) observed in the Saricakaya and Murdunu-

Göynük basins also suggests down-going slab segmentation (e.g., ridge subduction; Ramos, 2009). Triassic metamorphism and shortening are also observed within the İstanbul Zone (Okay and Tüysüz, 1999), suggesting continued inter-terrane proximity.

8.3 200-115 Ma

Detrital zircon U-Pb data reveal a period of regional magmatic quiescence from >200-115 Ma (Fig. 12 A), consistent with a passive margin, flat slab subduction, a transform plate boundary, or some combination of these scenarios. Analysis of a Jurassic sandstone (15YP04) from the Saricakaya Basin (Fig. 8) unconformably overlying Sakarya Zone basement (Fig. 3) yields a unimodal age peak at ~325 Ma, with very few Precambrian grains. Zircon U-Pb data from samples collected from the underlying Karakaya Complex proximal to our study area by P. Ustaömer et al., (2011) and T. Ustaömer et al., (2016) yield abundant Triassic dates, which are absent in our Jurassic sample. This, and the presence of a regional transgression (Okay and Tüysüz, 1999) indicates that during the Jurassic-Early Cretaceous the Karakaya Complex and overlying Jurassic-Early Cretaceous sediments of the Central Sakarya Basin were still submerged and significant topography had yet to develop (Fig 12 C). Thus, our data suggests magmatic quiescence driven by any type of subduction and associated orogenesis is unlikely.

8.4 115-80 Ma

Late Cretaceous granitoids are located along the northern margin of the İstanbul Zone (~150 km north of the İAS; Fig. 2 inset) and absent within the Sakarya Zone as well as the Moesian and Scythian platforms (e.g., Banks and Robertson, 1997). The distribution of these granitoids is consistent with a north-dipping Late Cretaceous subduction zone along the southern margin of the Sakarya Zone and not the İstanbul Zone (c.f., Akbayram et al., 2016), implying these terranes sutured during or prior to pluton emplacement (i.e., closure of the Intra-Pontide

Ocean ≥ 115 Ma; Fig. 12). Detrital zircon U-Pb data indicate magmatism re-initiated at ~115 Ma, and until 100 Ma is characterized by an intermediate to minimally evolved εHf pull-down (Fig. 12 A), interpreted as crustal thickening of the Sakarya Zone. At 100 Ma a major deviation from this trend towards more juvenile εHf values is observed, interpreted as initiation of an intra-oceanic subduction zone to the south (Fig. 12 D).

Blueschists of the Tavşanli Zone contain arc detritus (Okay et al., 1996), experienced HP-LT metamorphism between 90-80 Ma (Okay et al., 1998; Sherlock et al., 1999; Sherlock and Kelly, 2002) and are overthrust by ophiolites with ~95 Ma metamorphic soles (van Hinsbergen et al., 2016). These data serve as evidence that from 100-80 Ma the Tavşanli Zone was part of the down-going plate of an intra-oceanic subduction zone. The timing of these independent observations coincides with increasing magmatism and an εHf pull-down to highly evolved εHf values only observed in Late Cretaceous zircons analyzed from within Paleogene terrigenous units of the Saricakaya foreland basin (Fig. 12 A), in support of our interpretation that parts of the Tavşanli Zone were incorporated into the mantle wedge at this time (Fig. 12 D). Zircons of similar age from within the northerly Murdunu-Göynük Basin exhibit a more subdued pull-down (Fig. 12 A), interpreted as continued crustal thickening along the northern subduction zone (Fig. 12 D).

8.5 80-66 Ma

From 80-66 Ma magmatism peaks, wanes, and ceases. After synchronous pull-downs of varying magnitudes, an εHf pull-up is observed within Cretaceous units of the northern Murdunu-Göynük Basin (Fig. 12 A), interpreted as crustal thinning, a function of rapid slab roll-back which drove back-arc extension, opened the final portion of the Western Black Sea and subsequently translated the sutured Sakarya-İstanbul Zone (i.e., Western Pontides) to the south

(Fig. 12 E). A vertical array, observed in similar aged grains from the Saricakaya Basin is interpreted to represent intra-oceanic slab break-off, whose melts were sourced from both crustal and mantle reservoirs (Fig. 12 E). Vertical arrays produced from melt migration through heterogeneous continental crust can be ruled out due to the oceanic nature of the upper plate. A single zircon analyzed from a volcaniclastic horizon within the Saricakaya Basin (15YP13) yields a concordant U-Pb age of ~66 Ma, defines a small εHf pull-down, and precedes total arc shut-off (Fig. 12 A). We interpret the 66 Ma εHf pull-down followed by complete absence of zircon U-Pb ages to represent crustal thickening and total arc shut-off respectively, a result of transition to low angle subduction, and incipient collision between the Tavşanli Zone and Western Pontides (Figs. 12 E).

8.6 <65 Ma

From 65-55 Ma arc magmatism ceases (Fig. 12 A), interpreted as mantle wedge shut down within both subduction zones, a result of low angle subduction (Fig 12 F), which ultimately drove exhumation of basement units (i.e. Karakaya Complex ±Variscan Granitoids). Interbedded tuffaceous horizons of the Saricakaya Basin yield maximum depositional ages of ~52 and 48 Ma (Fig. 10), serving as a maximum constraint to the age for overlying sediments. Maximum depositional ages of terrestrial strata within the Saricakaya Basin are notably unrepresentative of their true depositional age (Fig. 8), serving as further evidence for arc shut-off and syn-collisional tectonism (e.g., Gehrels 2014).

Zircon U-Pb coupled with Lu-Hf data enable discrimination of sources contributing to the Saricakaya basin fill, which include Carboniferous zircons that exhibit a range of evolved εHf values from the Söğüt Granite (P. Ustaömer et al., 2011; this study), sporadic Jurassic zircons from the Murdunu Formation of the Central Sakarya Basin (e.g., Altiner et al., 1991) or possibly the Central Pontides (Gücer et al., 2016), Campanian zircons that exhibit highly evolved εHf values from the Tavşanli Zone, and moderately evolved-intermediate εHf values from the Central Sakarya Basin. Precambrian and older grains are likely recycled from ancient Laurasian passive margin strata that mantled the Pontides prior to orogenesis, whose primary sources are the İstanbul Zone (P. Ustaömer et al., 2005) and the Eastern European Craton (Okay et al., 2013), which were deposited into the Central Sakarya Basin and reworked into the Saricakaya Basin during collision (Fig. 12 F). It is also likely that a portion of Precambrian grains within the Saricakaya basin are sourced from Gondwanan passive margin strata whose primary sources are Pan African terranes and older African cratons (e.g., Kröner and Şengör, 1990).

Volcaniclastic samples collected from the Saricakaya Basin exhibit zircon crystallization ages ranging between 52-48 Ma, which overlap with ages from granitoids of the Tavşanli Zone (Harris et al., 1994; Okay et al., 1998) and may be genetically related to Paleogene plutonism within the Sakarya and İstanbul Zones (Fig 2; inset). The older of the two samples (52 Ma) exhibits a jump defined by the youngest forearc detrital grain (66 Ma; 15YP13) from evolved to minimally intermediate followed by a small pull-down from 52-48 Ma, which we interpret as a second episode of slab break-off followed by renewed underthrusting and crustal thickening (e.g., DeCelles et al. 2011; Fig 12 F). Return to underthrusting is also supported by the presence of the southeast directed northern Söğüt thrust that juxtaposes Sakarya Zone basement structurally above Paleogene foreland basin sediments (Fig. 3). The Neogene southward sweep of basic magmatism (e.g., Dilek and Altunkaynak, 2009) was likely a result of this syn-collisional crustal thickening, which ultimately lead to lithospheric delamination (Fig. 12 F).

9. CONCLUSIONS

Detrital zircon U-Pb geochronology in conjunction with Lu-Hf isotopes serve as a streamlined approach for testing and refining tectonic models and complements paleomagnetic, geophysical, petrologic, and field based datasets, all of which must ultimately must be employed in order to understand the geology of a region. Our findings suggest that an Andean-style subduction zone located on the southern margin of the Sakarya Zone along with a southern intra-oceanic subduction zone synchronously facilitated the closure of the İzmir-Ankara Ocean from at least 100 Ma to at least 75 Ma. Elements of previous models are integral to the tectonic history of the region, but cannot independently explain NW Turkey's tectonic evolution. In light of our U-Pb and Lu-Hf datasets and synthesis, a viable Alpine tectonic model involves the following:

120-100 Ma:

- Initiation of Andean-style subduction along the southern margin of the Pontides.
- Suturing of the İstanbul and Sakarya Zones (Western Pontides)
- Initiation of İzmir-Ankara intra-oceanic subduction

100-80 Ma:

- South-directed obduction of İzmir-Ankara oceanic lithosphere
- HP-LT metamorphism of the Tavşanli Zone
- Melting of the Tavşanli Zone

80-65 Ma:

- Slab roll-back of the marginal Sakarya subduction zone
- Opening of the Western Black Sea
- Slab break-off within the İzmir Ankara intra-oceanic subduction zone
- Incipient collision

55 Ma-45 Ma:

- Collision of the Tavşanli and Sakarya Zones
- Slab break-off within the marginal Sakarya Zone subduction zone
- Emplacement of Early Eocene calc-alkaline plutons within the Tavşanli Zone ±Sakarya and İstanbul Zones
- Sakarya Zone crustal thickening

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Figure Captions:

Figure 1.

Terrane map of the Eastern Mediterranean. Pontide terranes include the Strandja Zone, the İstanbul Zone, the Sakarya Zone, and the Eastern Pontides. Anatolides include the Tavşanli Zone, Central Anatolian Crystalline Complex, Afyon Zone and the Menderes Massif. The Taurides are located to the south and east. Major suture zones include the Intra-Pontide suture, the İzmir Ankara Erzincan suture, and the Bitlis suture. Red lines indicate active structures, the white box indicates the mapping area, yellow ellipses represent sample locations and dark green shapes indicate the approximate locations of ophiolites. The bottom right inset represents the approximate locations of volcanic rocks (modified from Okay and Tüysüz, 1999; Ozclon, 2006; van Hinsbergen et al. 2016 & maps from ITU).

Figure 2.

Conceptual illustration of models describing the Alpine closure history of the Neotethyan oceans in NW Turkey. TB: Tauride Block, AFZ: Afyon Zone, TVZ: Tavşanli Zone, SZ: Sakarya Zone, L: Lithosphere, OC: Oceanic Crust. See text for details.

Figure 3.

Geologic map (modified from Okay et al. 2002), synthetic stratigraphic column (modified from Moix et al. 2008 and Yilmaz et al. 1997), and schematic cross-section of the Sakarya of the Sakarya River Valley.

Figure 4.

Concordia plots and probability density plots (PDP's) super-imposed on histograms from samples collected within the footwall of the Söğüt Thrust, where the x-axis is age in millions of years (log-scale) and the y-axis is number of analyses. Maximum depositional ages are indicated within concordia plots when applicable. Large black ellipses and red circles indicate areas that have been enlarged in order to facilitate qualitative data evaluation.

Figure 5.

Concordia plots and probability density plots (PDP's) super-imposed on histograms from samples collected within the hanging-wall of the Söğüt Thrust, where the x-axis is age in millions of years (log-scale) and the y-axis is number of analyses. Maximum depositional ages are indicated within concordia plots when applicable. Large black ellipses and red circles indicate areas that have been enlarged in order to facilitate qualitative data evaluation.

Figure 6.

Concordia plots and probability density plots (PDP's) super-imposed on histograms from samples collected from north of the Sakarya River Valley near the town of Göynük, where the-x axis is age in millions of years (log-scale) and the y-axis is number of analyses. Maximum depositional ages are indicated within concordia plots when applicable. Large black ellipses and red circles indicate areas that have been enlarged in order to facilitate qualitative data evaluation.

Figure 7.

Concordia plots and probability density plots (PDP's) super-imposed on histograms from a sample collected from northwest of Ankara where the-x axis is age in millions (log-scale) of years and the y-axis is number of analyses. Maximum depositional ages are indicated within concordia plots when applicable. Large black ellipses and red circles indicate areas that have been enlarged in order to facilitate qualitative data evaluation.

Figure 8.

Zircon PDP's from samples collected from the Saricakaya, Murdunu-Göynük & Orhaniye Basins. Insets on detrital zircon plots with ages from 0-450 Ma and bracket magmatism during the opening and closure of the Tethyan Oceans. Major orogenies are indicated by colored columns (Blue: Cadomian, Red: Variscan, Green: Cimmerian, Yellow: Alpine). Tuffs analyzed along with maximum depositional ages (MDA's) in this study are in the right-hand corner.

Figure 9.

Age vs. Epsilon Hf plots for all Mesozoic samples. Vertical error bars represent estimated ~3 epsilon unit reproducibility (±1.5) and horizontal errors bars represent estimated zircon U-Pb uncertainties at 2σ or ±2.5%. See text for detailed descriptions.

Figure 10.

Age vs. Epsilon Hf plots for all Cenozoic samples. Vertical error bars represent estimated ~3 epsilon unit reproducibility (±1.5) and horizontal errors bars represent estimated zircon U-Pb uncertainties at 2σ (±2.5%). See text for detailed descriptions.

Figure 11.

Cumulative detrital zircon U-Pb and Lu-Hf plots for data collected in the Saricakaya, Murdunu-Göynük and Orhaniye Basins. Color of data points indicate the depositional age of a sample; orange-Paleogene, green-Cretaceous, blue-Jurassic, and purple-Paleozoic. The shape of a data points indicates the lithology of the sample; circle-detrital, triangle-volcanic, and diamond-basement.

Figure 12.

Cumulative detrital zircon U-Pb and Lu-Hf plots and conceptual Variscan-Alpine models of the tectonic evolution of NW Turkey. Color of data points indicate the depositional age of a sample; orange-Paleogene, green-Cretaceous, blue-Jurassic, and purple-Paleozoic. The shape of a data points indicates the lithology of the sample; circle-detrital, triangle-volcanic, and diamond-basement. TB; Tauride Block, AFZ; Afyon Zone, TVZ; Tavşanli Zone, LN; Lycian Nappes, KC; Karakaya Complex, SZ; Sakarya Zone, ISZ; İstanbul Zone, SKB; Saricakaya Basin, GB; Göynük Basin, L; Lithosphere, OC; Oceanic Crust, Eop; Eocene plutons, Pp; Permian plutons, GB; Göynük Basin, OB; Orhaniye Basin. See section 8 for details.

Figures

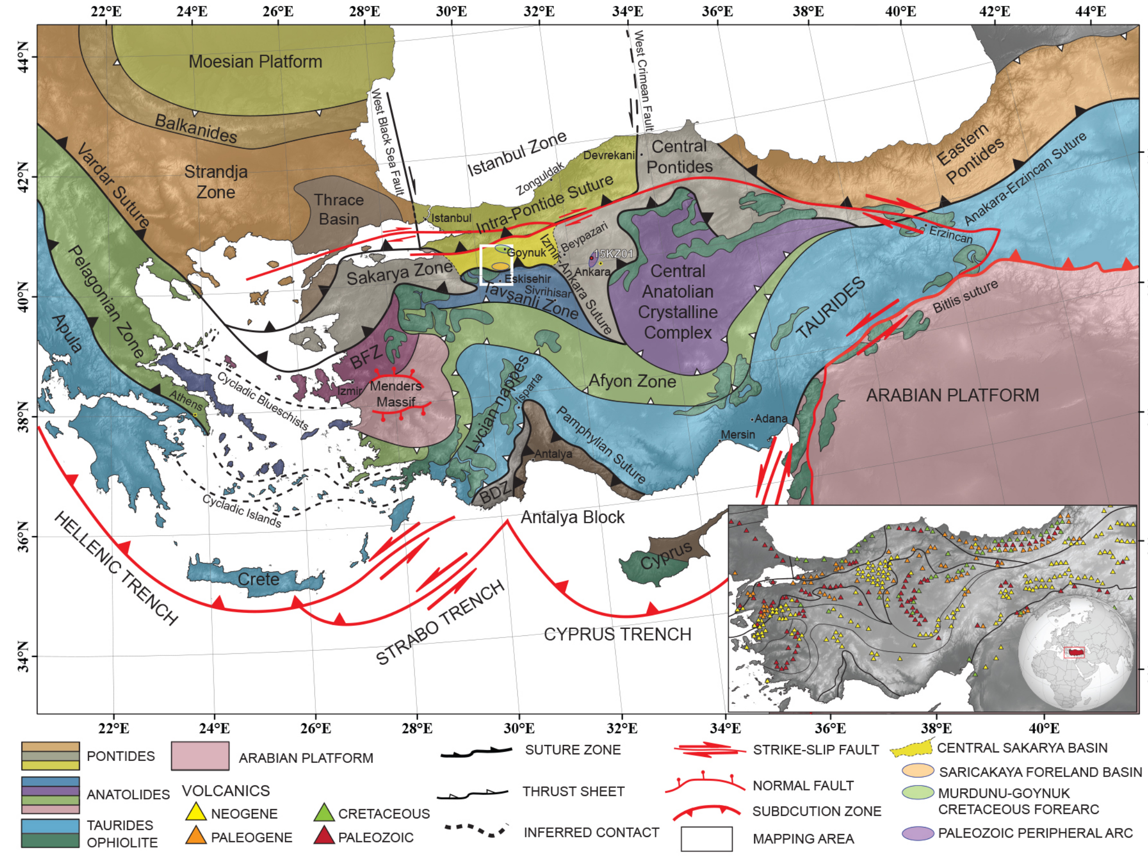


Figure 1

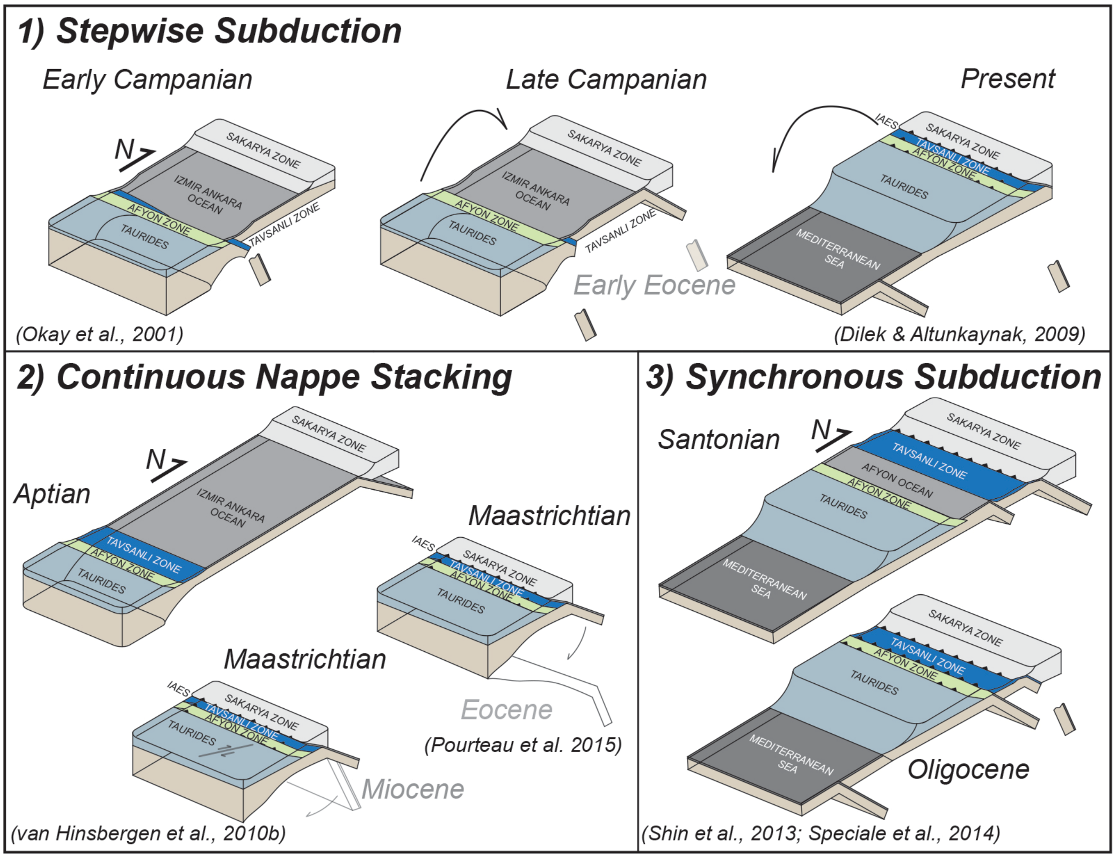
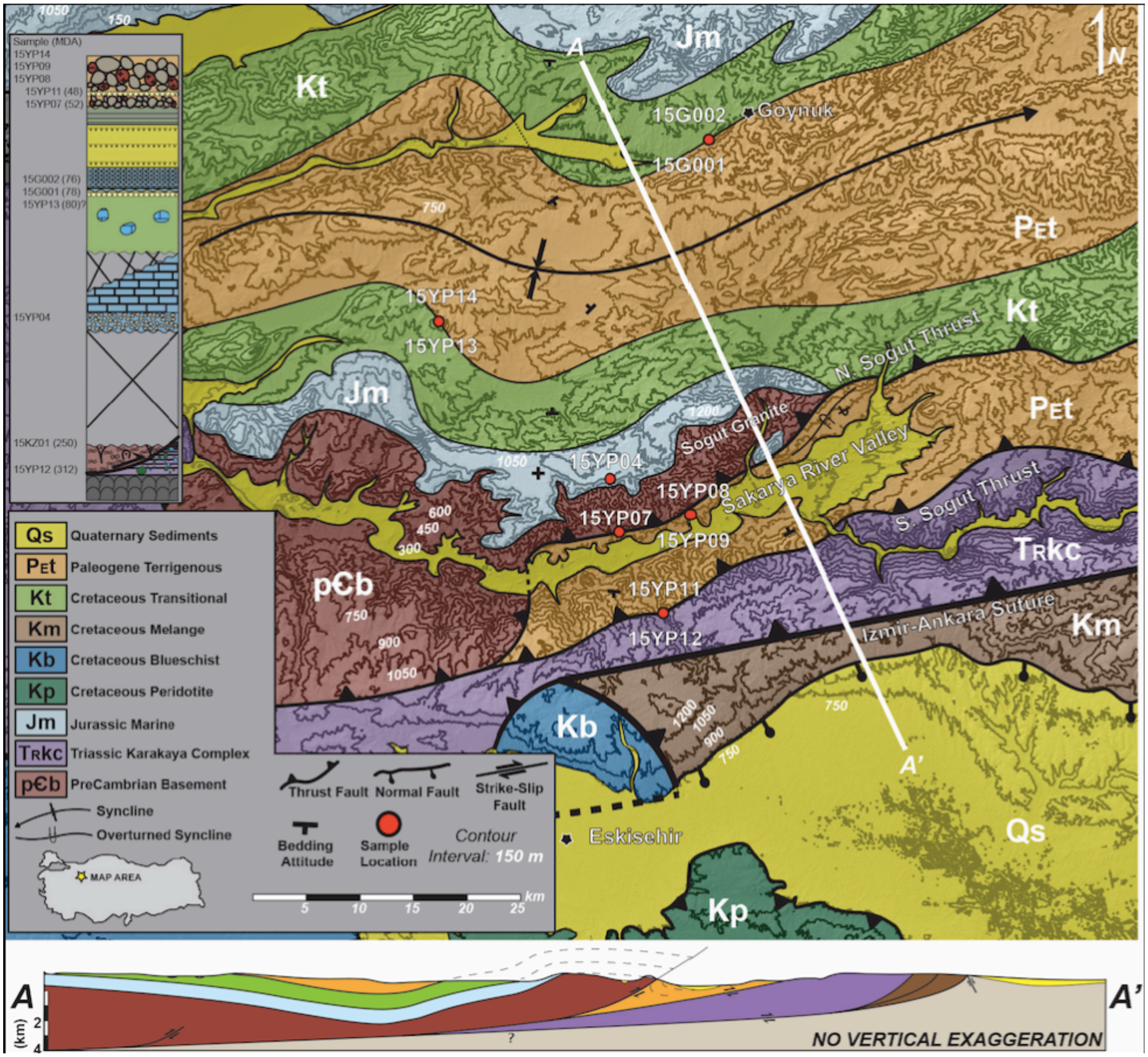
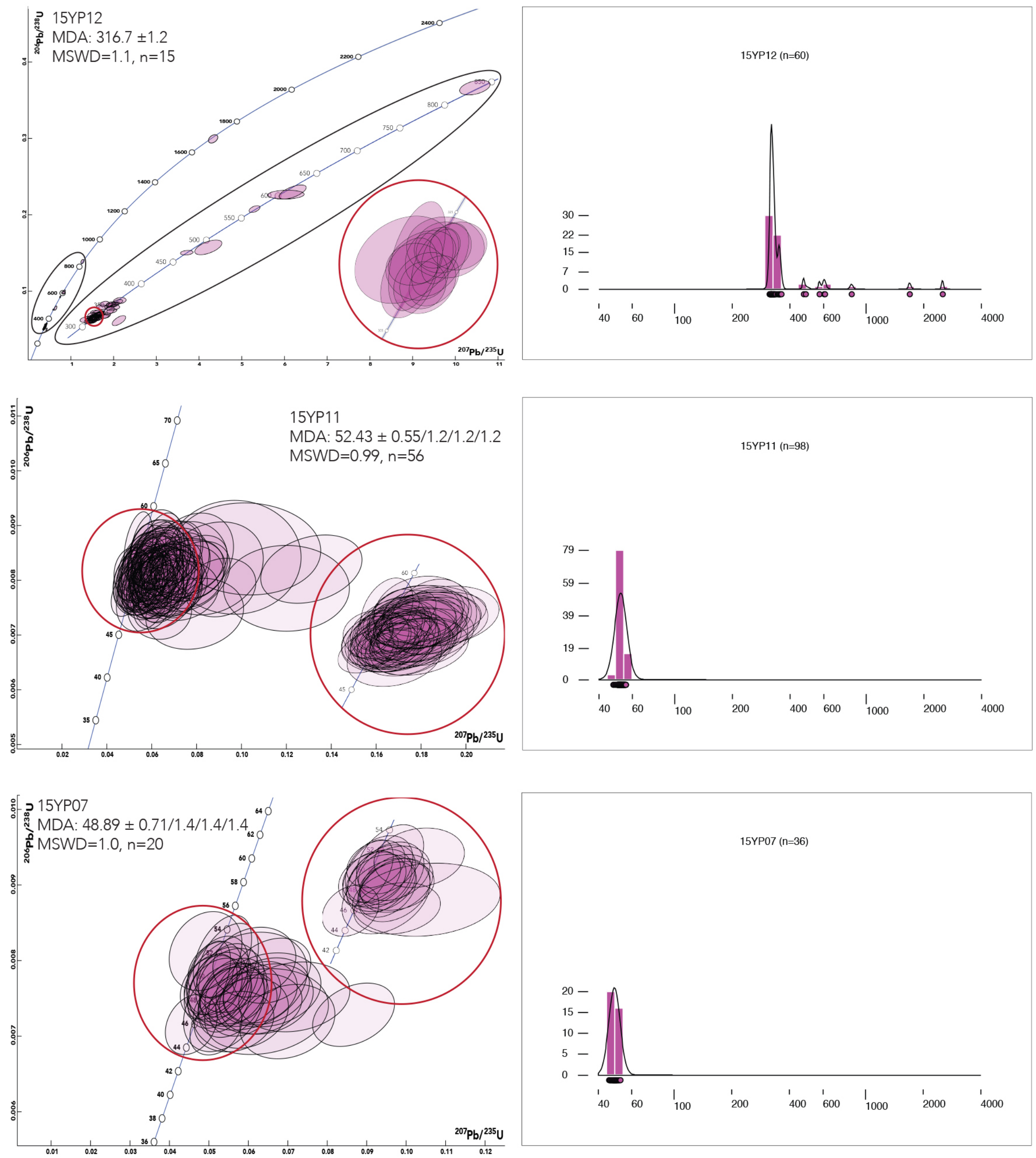

1) Stepwise Subduction
Early Campanian
Late Campanian
Present
N
SAKARYA ZONE
IZMIR ANKARA OCEAN
AFYON ZONE
TAURIDES
TAVSANLI ZONE
IAES
Early Eocene
MEDITERRANEAN SEA
(Okay et al., 2001)
(Dilek & Altunkaynak, 2009)
2) Continuous Nappe Stacking
Aptian
Maastrichtian
Eocene
Miocene
(Pourteau et al. 2015)
(van Hinsbergen et al., 2010b)
3) Synchronous Subduction
Santonian
AFYON OCEAN
Oligocene
(Shin et al., 2013; Speciale et al., 2014)

Figure 2



Sample (MDA)
15YP14
15YP09
15YP08
15YP11 (48)
15YP07 (52)
15G002 (76)
15G001 (78)
15YP13 (80)?
15YP04
15KZ01 (250)
15YP12 (312)
Qs Quaternary Sediments
PƐt Paleogene Terrigenous
Kt Cretaceous Transitional
Km Cretaceous Melange
Kb Cretaceous Blueschist
Kp Cretaceous Peridotite
Jm Jurassic Marine
TRkc Triassic Karakaya Complex
pЄb PreCambrian Basement
Syncline
Overturned Syncline
MAP AREA
Thrust Fault
Normal Fault
Strike-Slip Fault
Bedding Attitude
Sample Location
Contour Interval: 150 m
5 10 15 20 25 km
N
A
A'
Goynuk
Eskisehir
N. Sogut Thrust
S. Sogut Thrust
Sogut Granite
Sakarya River Valley
Izmir-Ankara Suture
(km) 2 4
NO VERTICAL EXAGGERATION

Figure 3


15YP12
MDA: 316.7 ±1.2
MSWD=1.1, n=15
15YP12 (n=60)
15YP11
MDA: 52.43 ± 0.55/1.2/1.2/1.2
MSWD=0.99, n=56
15YP11 (n=98)
15YP07
MDA: 48.89 ± 0.71/1.4/1.4/1.4
MSWD=1.0, n=20
15YP07 (n=36)
206Pb/238U
207Pb/235U

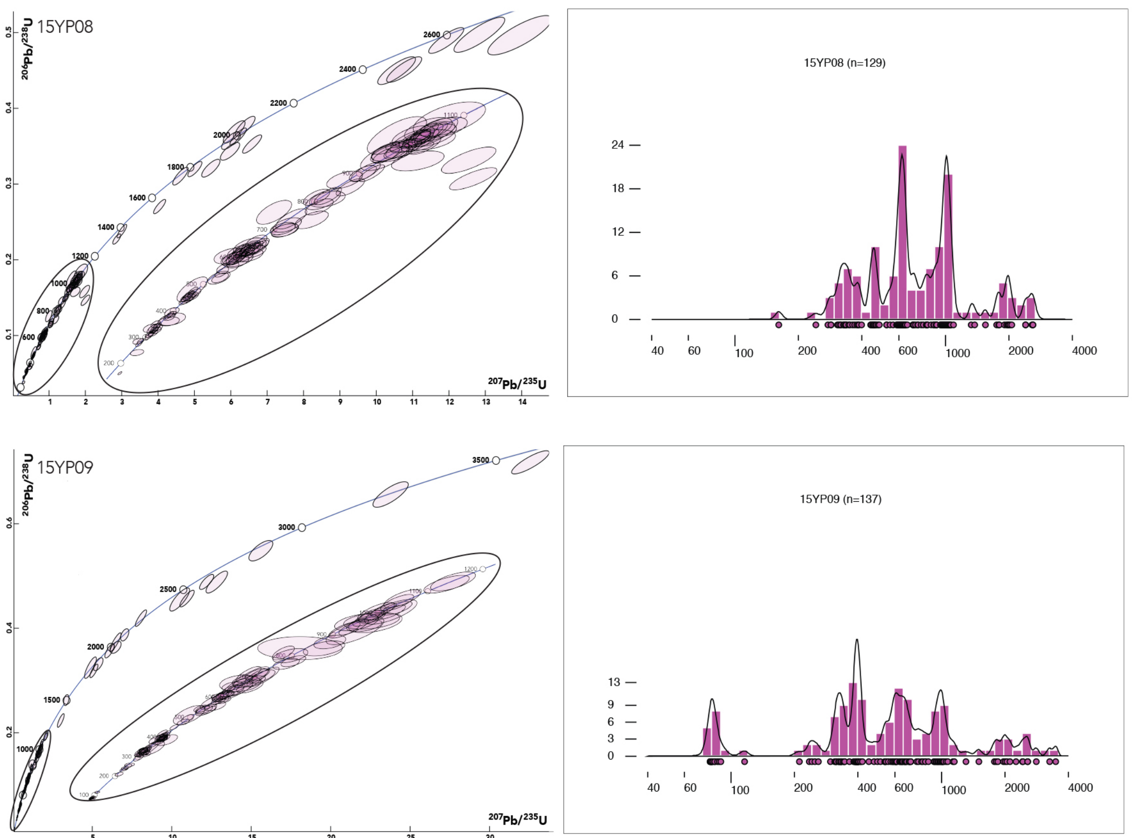


Figure 4

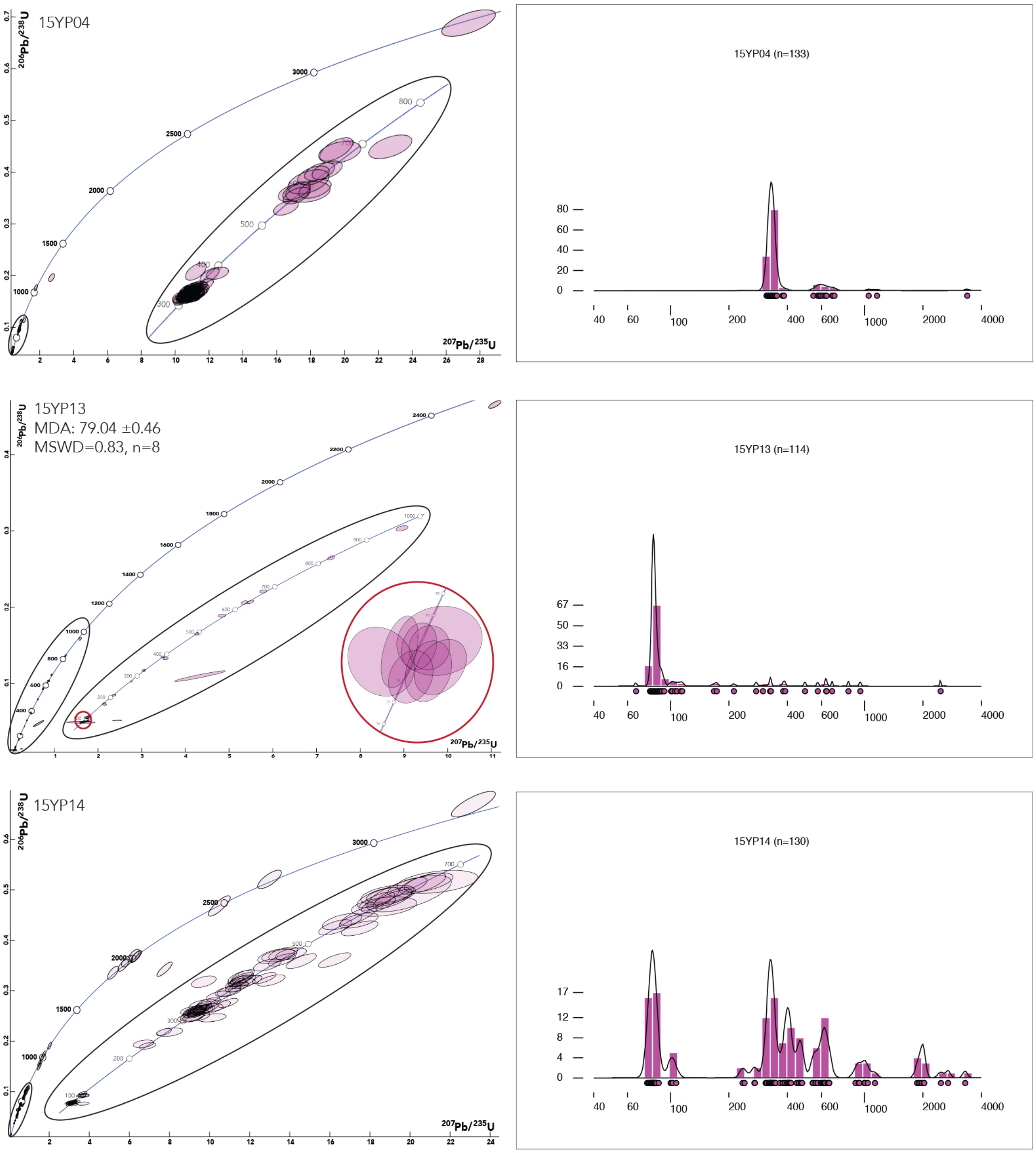

15YP04
15YP04 (n=133)
15YP13
MDA: 79.04 ±0.46
MSWD=0.83, n=8
15YP13 (n=114)
15YP14
15YP14 (n=130)
$^{206}Pb/^{238}U$
$^{207}Pb/^{235}U$

Figure 5

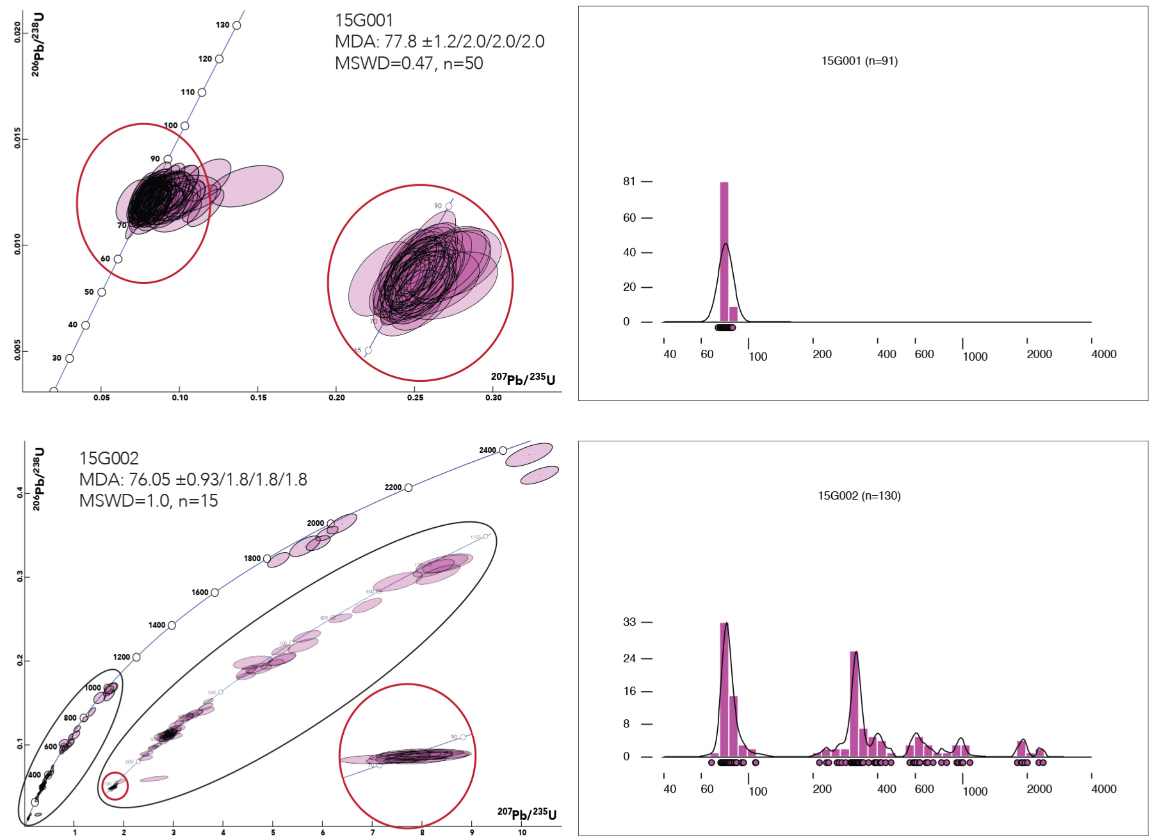


Figure 6

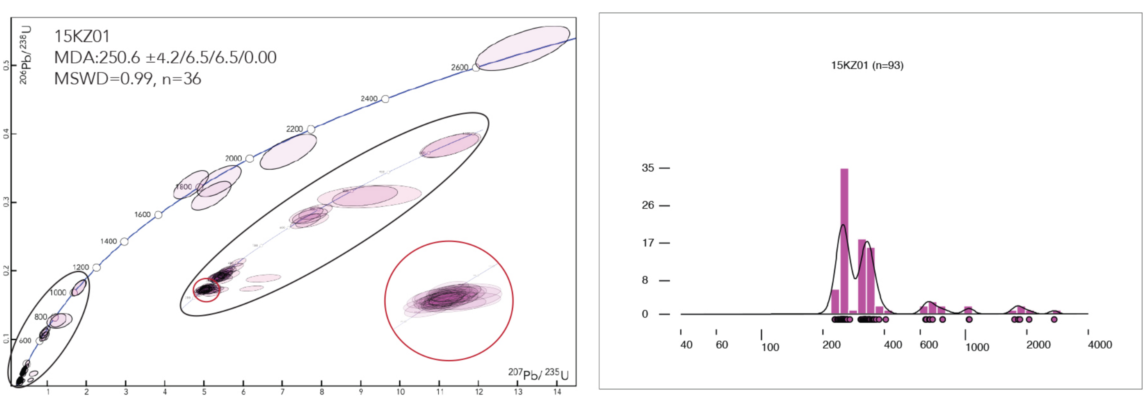
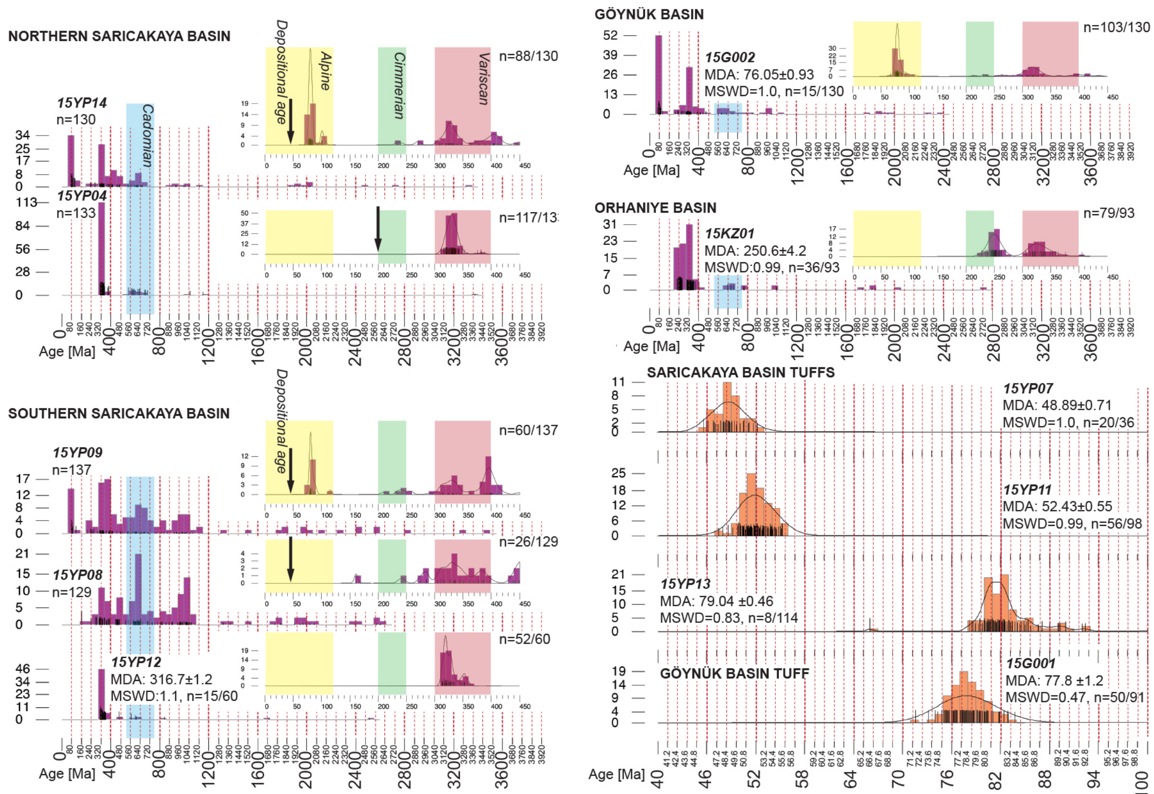


Figure 7



NORTHERN SARICAKAYA BASIN
15YP14
n=130
15YP04
n=133
n=88/130
n=117/133
Depositional age
Alpine
Cimmerian
Variscan
Cadomian
SOUTHERN SARICAKAYA BASIN
15YP09
n=137
15YP08
n=129
15YP12
MDA: 316.7±1.2
MSWD:1.1, n=15/60
n=60/137
n=26/129
n=52/60
GÖYNÜK BASIN
15G002
MDA: 76.05±0.93
MSWD=1.0, n=15/130
n=103/130
ORHANIYE BASIN
15KZ01
MDA: 250.6±4.2
MSWD:0.99, n=36/93
n=79/93
SARICAKAYA BASIN TUFFS
15YP07
MDA: 48.89±0.71
MSWD=1.0, n=20/36
15YP11
MDA: 52.43±0.55
MSWD=0.99, n=56/98
15YP13
MDA: 79.04 ±0.46
MSWD=0.83, n=8/114
GÖYNÜK BASIN TUFF
15G001
MDA: 77.8 ±1.2
MSWD=0.47, n=50/91
Age [Ma]

Figure 8

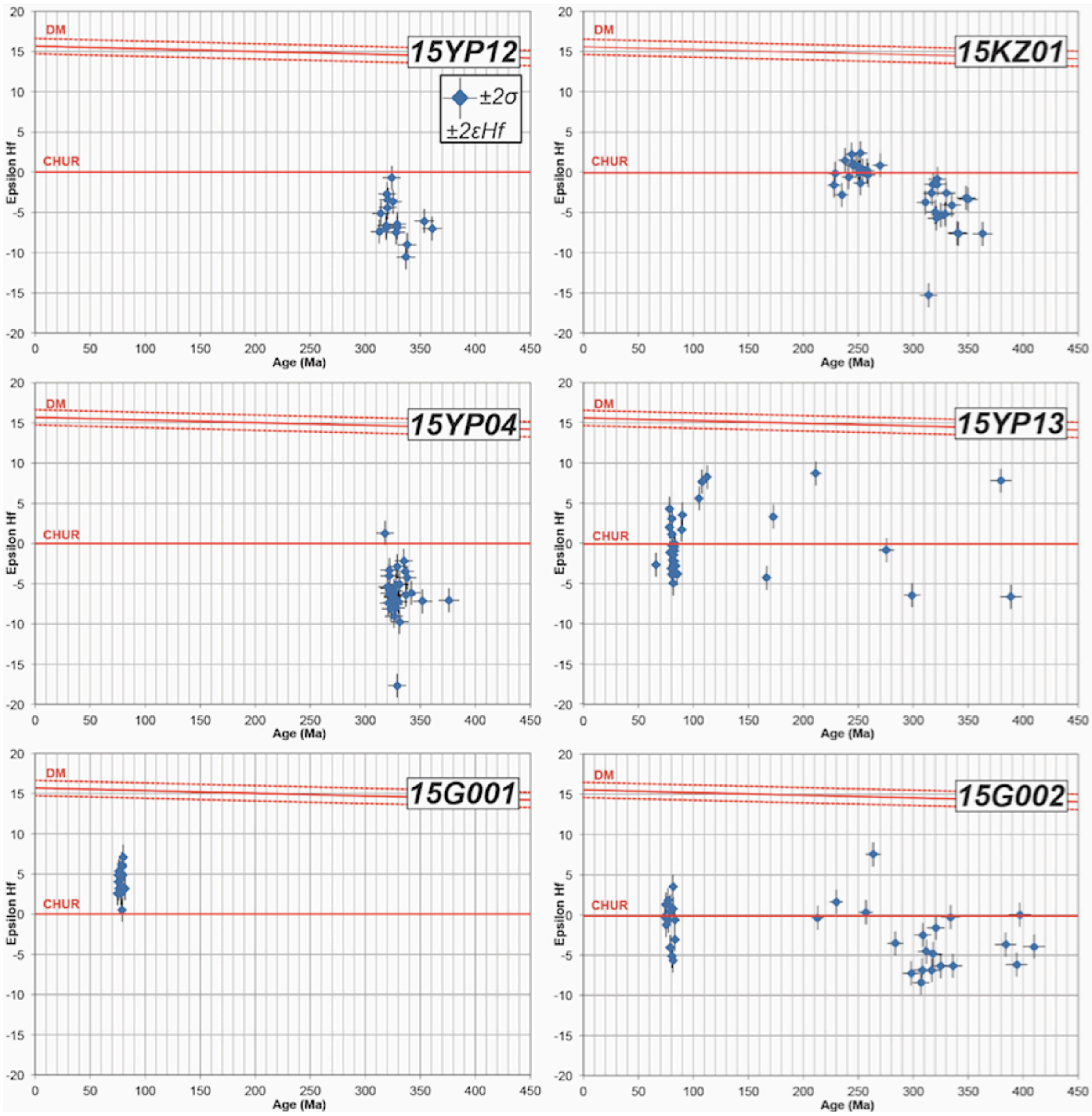

15YP12
15KZ01
15YP04
15YP13
15G001
15G002
DM
CHUR
±2σ
±2εHf
Epsilon Hf
Age (Ma)

Figure 9

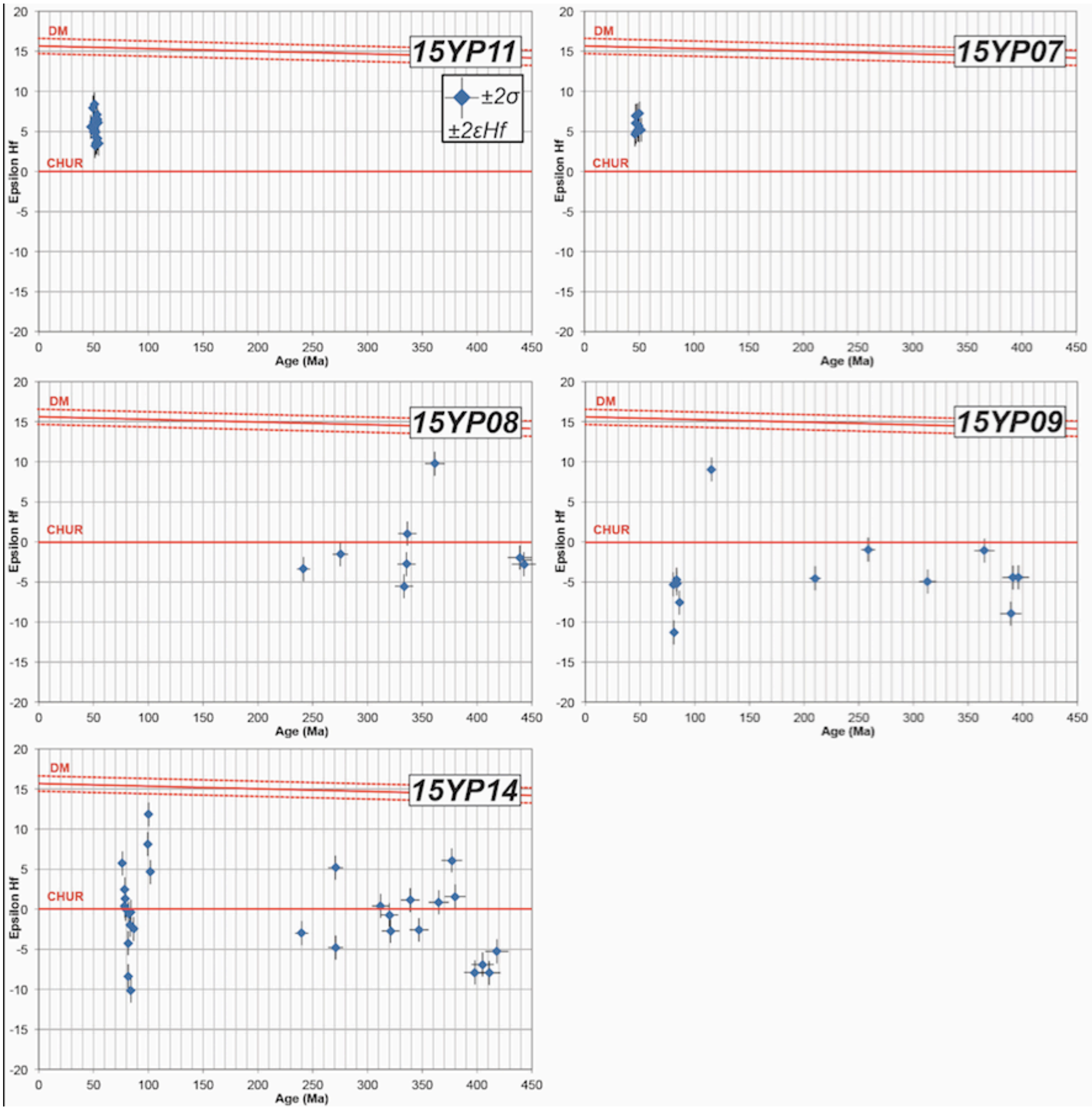
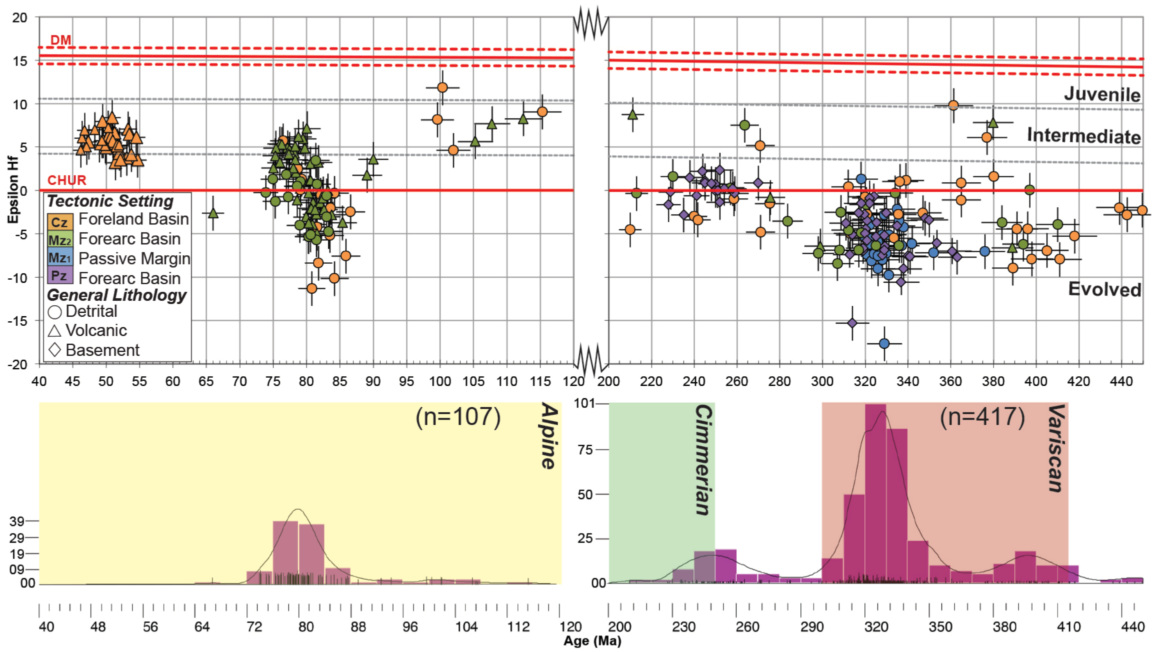

15YP11
15YP07
15YP08
15YP09
15YP14
DM
CHUR
±2σ
±2εHf
Epsilon Hf
Age (Ma)

Figure 10



DM
CHUR
Juvenile
Intermediate
Evolved
Epsilon Hf
Tectonic Setting
Cz Foreland Basin
Mz2 Forearc Basin
Mz1 Passive Margin
Pz Forearc Basin
General Lithology
Detrital
Volcanic
Basement
(n=107)
Alpine
Cimmerian
(n=417)
Variscan
Age (Ma)

Figure 11

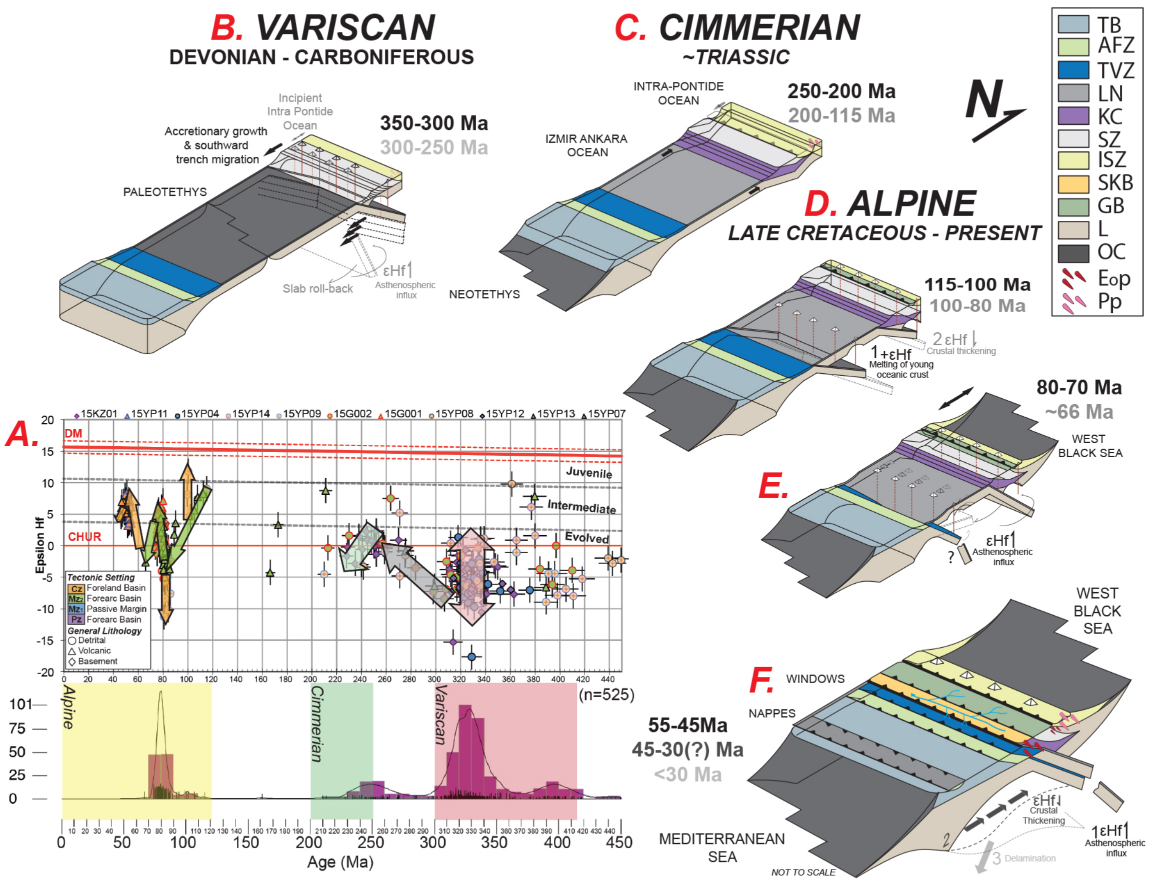

B. VARISCAN
DEVONIAN - CARBONIFEROUS
C. CIMMERIAN
~TRIASSIC
D. ALPINE
LATE CRETACEOUS - PRESENT
350-300 Ma
300-250 Ma
250-200 Ma
200-115 Ma
115-100 Ma
100-80 Ma
80-70 Ma
~66 Ma
55-45Ma
45-30(?) Ma
<30 Ma
Accretionary growth & southward trench migration
Incipient Intra Pontide Ocean
PALEOTETHYS
NEOTETHYS
Slab roll-back
INTRA-PONTIDE OCEAN
IZMIR ANKARA OCEAN
WEST BLACK SEA
MEDITERRANEAN SEA
WINDOWS
NAPPES
NOT TO SCALE
TB
AFZ
TVZ
LN
KC
SZ
ISZ
SKB
GB
L
OC
Eop
Pp
A.
Epsilon Hf
DM
CHUR
Juvenile
Intermediate
Evolved
Tectonic Setting
Foreland Basin
Forearc Basin
Passive Margin
Forearc Basin
General Lithology
Detrital
Volcanic
Basement
15KZ01 15YP11 15YP04 15YP14 15YP09 15G002 15G001 15YP08 15YP12 15YP13 15YP07
Alpine
Cimmerian
Variscan
(n=525)
Age (Ma)
E.
F.

Figure 12

Appendices

Appendix 1: Detailed Terrane and Basin Descriptions

2.1 PONTIDES

2.1.1 Standja Zone

The Strandja Zone, also known as the İstranca Massif (Aydin, 1974) is located in northwesternmost Turkey (Fig. 1). The southern margin of the terrane is juxtaposed against the Sakarya Zone via the E/W striking Vardar Suture. To the west the Vardar Suture strikes northwest and wraps around the Strandja Zone, which in turn is in tectonic contact with the southerly Pelagonian Zone. To the east, the Strandja Zone is truncated by the north striking, dextral West Black Sea Fault. To the southeast, its contact with the Istanbul Zone is covered by a thick, greater than ~20 km wide sequence of undisturbed Middle Eocene carbonates (Okay et al., 1996) (Fig. 2).

The basement of the Strandja Zone consists of felsic gneisses and migmatites intruded by Carboniferous - Permian granitoids emplaced during the Variscan orogeny (Okay and Tüysüz, 1999). Basement units are in turn unconformably overlain by Paleozoic and Early Mesozoic continental clastic sequences, volcanic rocks, and shallow marine carbonates, all of which have been subjected to latest Jurassic-earliest Cretaceous greenschist metamorphism based on K-Ar biotite cooling ages (Okay 1986; Okay et al., 1996). Paleozoic and Mesozoic sedimentary cover rocks are intruded by Late Cretaceous calc-alkaline, andesitic plutons emplaced during the progressive closure of the Vardar Ocean, which culminated by ~115 Ma based on hornblende Ar-Ar cooling ages of the metamorphic soles of suture zone peridotites near the Biga Peninsula (Okay et al., 1996). The most southeasterly portion of the terrane consists of a greater than 9 km thick sequence of Eocene and younger clastic sediments, collectively known as the Thrace Basin (e.g., Görür and Okay, 1996).

2.1.2 İstanbul Zone

The İstanbul Zone, also known as the İstanbul Nappe (Şengör et al. 1984a) is located along the southwestern lobe of the Black Sea and extends approximately 400 km E-W by 70 km N-S (Okay and Tüysüz, 1999). This terrane is juxtaposed against the Strandja Zone to the west via the dextral West Black Sea Fault. To the east, it is juxtaposed against the Central Pontides of the Sakarya Zone via the sinistral West Crimean Fault (Okay et al., 1994). To the south, the İstanbul Zone is in tectonic contact with the Sakarya Zone via the Late Triassic (Bozkurt et al., 2013), Early Cretaceous (Akbayram et al., 2013), pre-Santonian (Özcan et al., 2012), middle Late Cretaceous (Göncüoğlu et al., 2008), Turonian (Robertson and Ustaömer, 2004), pre-Cenomanian (Göncüoğlu and Erendil, 1990) Cenomanian (Tüysüz, 1999), Coniacian - Santonian (Yilmaz et al., 1995; Elmas and Yiğitbaş, 2001, 2005), Paleocene-Lutetian (Şengör and Yilmaz, 1981), Early Eocene (Okay et al., 1994; Akbayram et al., 2016), or Early Eocene-Oligocene (Görür and Okay, 1996) Intra-Pontide Suture (see Akbayram et al., 2016 for a detailed discussion). The İstanbul Zone is comprised of Cadomian (Pan-African) (P. Ustaömer et al., 2005) amphibolite-facies basement with intercalated tectonic lenses of micaschist and metadiorite (Şengör et al., 1984a). Basement rocks are in turn overlain by a sequence of transgressive Ordovician-Carboniferous clastic rocks, interpreted as passive margin sediments, resembling similar aged sedimentary packages of the Moesian Platform and are therefore interpreted to be part of the southern flank of Baltica prior to the opening of the Paleotethys (Okay et al., 1996). During the Early Devonian-Late Carboniferous (±Permian) Variscan Orogeny (Stampfli, 2000), marginal sediments were deformed, exhumed, faulted and folded diachronously from west to east (Okay and Tüysüz, 1999). Triassic transgressive sediments unconformably overlie Ordovician-Carboniferous tectonised units (Okay et al., 1996; Okay and

Tüysüz, 1999), which exhibit deformation related to the Cimmerian Orogeny. Triassic strata are unconformably overlain by Late Cretaceous sediments where Jurassic and Early Cretaceous sedimentary horizons are notably absent (Altiner et al., 1991). Extrusive and intrusive Late Cretaceous volcanic rocks are locally observed along the northern margin of the İstanbul Zone (Okay and Tüysüz, 1999) (Fig. 2; inset).

2.1.3 Sakarya Zone

The Sakarya Zone, as described by Okay (1984a) combines Şengör and Yilmaz, (1981)'s Sakarya Continent and Eastern Pontides. However, in this study, we treat the Eastern Pontides as a separate tectonic unit due to its contrasting Paleozoic-Cenozoic volcanic history (Fig. 2; inset). To the northwest, the Sakarya Zone is in tectonic contact with the Strandja Zone and the İstanbul Zone via the Vardar and Intra-Pontide sutures. The northeastern portion of the Sakarya Zone is known as the Central Pontides, and is characterized by Jurassic plutonic rocks, which exhibit contemporaneous HT-LP metamorphism (Gücer et al., 2016). The Central Pontides are located east of the İstanbul Zone and West Crimean Fault, north of the Central Anatolian Crystalline Complex and the Ankara Erzincan suture zone, west of the Eastern Pontides and the dextral Northern Anatolian Fault, and south of the Black Sea (Fig. 2). The southern margin of the Sakarya Zone (sensu-stricto Şengör and Yilmaz, 1981) from west to east is in tectonic contact with the Bornova Flysch Zone (BFZ), The Tavşanli Zone and the western margin of the Central Anatolian Crystalline Complex (Fig. 2).

The Basement of the Sakarya Zone is characterized by Early Paleozoic passive margin strata, which are metamorphosed, folded, faulted and intruded by Carboniferous ±Devonian granitoids emplaced during the Variscan Orogeny (Okay et al., 1996). Carboniferous plutons and basement gneisses yield zircon U-Pb ID-TIMS and U-Pb Ion Microprobe ages clustering around

~400 and ~310 Ma respectively (Okay et al., 1996; P. Ustaömer et al., 2011). The Karakaya Complex (Fig. 3) is located structurally below the Variscan basement (Okay et al., 2002) and consists of a ca. 3 km thick package of mafic Carboniferous, Permian and Triassic sediments (Okay and Tüysüz, 1999; Ustaömer et al., 2016) that underwent varying degrees of metamorphism during the Late Triassic Cimmerian Orogeny (Okay, 2000; Okay et al., 2002). The tectonic setting of the Karakaya Complex has been interpreted as an oceanic seamount (Pickett and Roberson, 1996), an oceanic plateau (Okay, 2000), an ensimatic fore-arc sequence (Göncüoğlu et al., 2000), or an oceanic intra-arc to fore-arc (Okay et al., 1996) (see Okay et al., 2002). Together, metamorphosed Early Paleozoic passive margin strata, Variscan basement, and the under-thrusted Karakaya Complex describe the basal lithologies of the Sakarya Zone (Okay et al., 2002; T. Ustaömer et al., 2016). Jurassic-Neogene sediments rest unconformably above basement lithologies, where the western Sakarya Zone contains conglomeratic strata, deposited during the Early Jurassic, overlain by a ~2 km thick limestone package deposited during the Middle Jurassic-earliest Late Cretaceous (Okay and Tüysüz, 1999). Late Cretaceous-Neogene strata rest depositionally above this limestone sequence, marked by an angular unconformity, which coarsens upward into marine turbidites interbedded with volcanic horizons, which transition into lagoonal and deltaic deposits. In turn, this sequence is unconformably overlain by fluvial deposits, which also contain volcanogenic horizons. A final enigmatic feature of the Sakarya Zone are abundant Late Cretaceous volcanogenic strata and the absence of their plutonic counterparts (Okay et al., 1996).

2.2 THE ANATOLIDES

2.2.1 Tavşanli Zone

The Tavşanli Zone (Okay, 1984a) strikes E-W for 250 - 300 km, has an average N-S width of ~50 km (Okay, 2008) and is in tectonic contact with the more northern Sakarya Zone via the İAS, whose defining feature is a Late Cretaceous blueschist belt, with lesser amounts of Triassic blueschists (Okay et al., 2002). Metamorphosed sediments consist of Paleozoic-Mesozoic passive margin strata capped by platform carbonates, representative of the northern margin of the Anatolides. During the Late Cretaceous (90-80 Ma), as a result of intra-oceanic subduction (van Hinsbergen et al., 2016 and references within), this zone underwent high-pressure low-temperature (HP-LT) metamorphism at approximately 20-24 kbar and 430-500 °C (Okay et al., 1998; Sherlock et al., 1999; Sherlock and Kelly, 2002). This immediately post dates initial obduction of the Lycian Nappes (~95 Ma; Önen, 2003; Celik et al., 2006), which contain oceanic crust of the İzmir-Ankara Ocean in the hanging-wall. To the east, the contact between the Tavşanli Zone and the Central Anatolian Crystalline Complex is obscured by Upper Cretaceous-Middle Eocene sediments of the Orhaniye (Fig 1.), Haymana-Polatli, and Tuz Gölü sedimentary basins (e.g., Nairn et al., 2013; Licht et al., 2017)

2.2.2 Afyon Zone

The Afyon Zone (Okay, 1984a), structurally beneath the Tavşanli Zone is characterized by Barrovian-type metamorphism resulting in amphibolite-greenschist facies metamorphism, reaching peak pressures and temperatures of ~10 kbar and temperatures of 350-400°C during the Paleocene (Candan et al., 2005). This metamorphic unit is observed for over 600 km, in tectonic contact with the Menderes Massif and the Tavşanli Zone to the west, the Central Anatolian Crystalline Complex to the east, and the Taurides to the south (Fig. 2).

The Afyon Zone is underlain by Pan-African basement mantled by low-grade, Late Paleozoic metamorphic sediments which fine up-section from Carboniferous conglomerates to Permian neritic platform-type sediments. Overlying Mesozoic sediments consist of Triassic-Late Cretaceous turbidites, which grade into sandstone beginning in the Paleocene and are interpreted to represent the proximal facies of the Anatolide-Tauride Blocks northern passive margin (Candan et al., 2005).

2.2.3 Nappe Sheets

Metamorphic soles of ophiolitic bodies thrusted over the Tavşanli Zone (Önen and Hall, 1993; Önen, 1993), Afyon Zone (Daşçi et al., 2014), and the Taurides (Çelik et al., 2006) (van Hinsbergen et al., 2016; Table 1) yield Cenomanian Ar/Ar apparent cooling ages of ~95 Ma. The most well known of these bodies are the Lycian Nappes, of southwestern Turkey, which are thrusted over the SW Tauride block, between the Menderes Massif in the west and the Antalya Block in the east (Fig. 1). These ophiolitic units are related to obduction of a south-directed thrust sheet along an intra-oceanic subduction zone within the İzmir-Ankara Ocean that was active from the Aptian-latest Cretaceous/earliest Paleocene (e.g., van Hinsbergen et al., 2016). During Early Paleogene syn-collisional orogenesis, these ophiolites were translated southward in the hanging-wall of younger south-directed thrust sheets.

2.3 BASINS

2.3.1 Central Sakarya Basin

The Central Sakarya Basin is the primary basin in NW Turkey (Okay and Tüysüz, 1999). This basin is further divided into the north-central Murdunu-Göynük Basin, which consists primarily of Jurassic marine and Cretaceous shallow marine to transitional sediments (Altiner et al., 1991), where minor outcrops north of the Intra-Pontide Suture are also observed. The more southern portion of the Central Sakarya Basin is known as the Saricakaya Basin, deposited on the southern margin of the Sakarya Zone, north of the İzmir-Ankara Suture. This basin primarily consists of Tertiary red beds unconformably overlying basement and Early-Middle Mesozoic sediments (Okay and Tüysüz, 1999).

2.3.2 Murdunu-Göynük Basin

Prior to closure of the Intra-Pontide Ocean, an eastward narrowing embayment (morphologically similar to the Gulf of California) existed between the İstanbul and Sakarya Zones (Okay et al., 1994; Okay et al., 1996; Görür, 1997). This embayment served as the primary depocenter for detritus shed from the Cretaceous arc of the Western Pontides (Fig. 1). Outcrops of this forearc basin are abundant in the northern Sakarya Zone and to a lesser extent in southern İstanbul Zone. In the Sakarya Zone, strata is exposed in a belt of alternating NE-SW trending anticlines and synclines (e.g., Açikalin et al., 2014), whereas in the İstanbul Zone only smaller lenses of the lowest members are observed within the Northern Anatolian Fault Zone (e.g., Genç and Tüysüz, 2010). The lowermost members of the Murdunu-Göynük Basin were deposited above a pre-Jurassic continental basement (Açikalin et al., 2014) and are characterized by Jurassic volcanic rocks which fine up-section to Early Cretaceous pelagic carbonates (Şengör and Yilmaz, 1981; Altiner et al., 1991; Okay and Tüysüz, 1999; Tüysüz, 1999). Late Cretaceous strata are observed throughout the basin and consist of a thick ~1000 m sequence of volcanogenic turbidites with Cenomanian-Campanian depositional ages (Okay and Tüysüz, 1999). In the latest Cretaceous a coarsening upward sequence is observed, which contains sandstones and conglomerates (Açikalin et al., 2014). The Murdunu-Göynük Basin likely represents more proximal facies of a Late Cretaceous forearc basin.

2.3.3 Saricakaya Basin

Sedimentary deposits from the southern portion of the Central Sakarya Basin are located in and to the north of the Sakarya River Valley near the town of Eskişehir. The northern margin of the Sakarya River Valley is characterized by a SSW directed thrust fault (the Northern Söğüt Thrust), which juxtaposes a Carboniferous pluton (Söğüt granite; ~325 Ma; Ustaömer et al.. 2011) over terrigenous Paleogene red beds that are locally folded into an overturned SSE verging syncline. This basin is also incorporated into the hanging-wall of another SSE directed thrust fault containing Paleozoic and Mesozoic accretionary units in its footwall, such as the Permo-Triassic marbles of the Karakaya Complex (Ustaömer et al., 2011) as well and Triassic and Cretaceous Ophiolitic material (Okay et al., 2002). South of this imbricate thrust stack HP-LT blueschist rocks of the Tavşanli Zone are observed (Fig. 3).

Here we subdivide the Saricakaya basin into the north and south Saricakaya basin based upon whether the location is in the hanging-wall or footwall of the Northern Söğüt Thrust. The southern Saricakaya Basin (i.e., footwall) consists of a metamorphosed greenschist(?) basement, overlain by Permo-Triassic marbles, which are in turn unconformably overlain by a sequence of carbonaceous Jurassic sandstone beds, above which Paleogene red beds are present, consisting of a sequence of coarsening up conglomerates with interbedded Early Eocene tuffaceous units. Here we sampled an outcrop of the basement in the southern portion of the basin, two finer grained conglomeratic beds, and two underlying volcanic tuffs (Fig. 3).

The northern Saricakaya Basin (hanging wall) is stratigraphically similar to the southern basin, however it contains Cretaceous shallow marine to transitional sediments between the Jurassic and Paleogene sections unlike the southern basin.

2.3.4 Orhaniye Basin

Part of the greater Haymana-Polatli-Orhaniye basin complex (e.g., Narin et al., 2013), located southeast of the Neogene Galatean volcanic arc and west of the Central Anatolian Crystalline Complex, within the south pointing horn of the Sakarya Zone, the Orhaniye basin is the most northerly depocenter of the complex and has been interpreted to represent a peripheral forearc sub-basin (Licht et al., 2017; Dickinson and Seely, 1979). A continuous record of Upper Cretaceous-Eocene strata is deposited above the Northern Anatolian Ophiolitic Mélange, which consists of Upper Jurassic-Lower Campanian turbidites, ophiolites, pillow basalts, olistostromes, carbonates and radiolarites. The lower member of the Orhaniye basin is known as the Dikmendede formation, which exhibits variable thickness ranging from 200-850 m and is dominated by deep marine turbidites deposits, which generally fine up section and are capped by coarser grained clastics, interpreted to represent a deltaic environment, which were deposited during the Maastrichtian to perhaps the Lower Paleocene. The Dikmendede formation represents a progradational sequence, which is intruded by dike complexes emplaced during the Paleocene. The top of the Dikmendede formation is defined by an unconformity, above which sandstone, pedogenic red mudstone, and carbonate rich clastic material is observed. Collectively this sedimentary sequence is interpreted to represent a Paleocene-Middle Eocene lagoonal or coastal environment, known as the Uzunçarşidere formation (Koçyigit et al., 1988; Koçyigit, 1991).

Appendix 2: Sample Descriptions and Locations

S. Saricakaya Basin

Samples	Description	Location
15YP09	Volcaniclastic sandstone in Paleogene series of Saricakaya, 15 m above the appearance of basement clasts in the Pg section	N40°04'09.6" E30°44'37.5"
15YP08	Volcaniclastic sandstone in Paleogene series of Saricakaya, 15 m below the appearance of basement clasts in the Pg section (unconformability)	N40°04'09.6" E30°44'37.5"
15YP11	Volcaniclastic sandstone in Paleogene series of Saricakaya, ~30 m above the base of the Pg section	N40°01'18.9" E30°39'22.9"
15YP07	Volcaniclastic sandstone in Paleogene series of Saricakaya, random stratigraphic location	N40°03'08.4" E30°37'13.2"
15YP12	Greenschist (?), basement of Pontides, below Pg section and next to the Suture	N40°01'18.9" E30°39'22.9"

N. Saricakaya Basin

Samples	Description	Location
15YP14	Paleogene sandstone, Yenipazar section, 10m above the disconformity with Maastrichian flysch	N40°10'01.7" E30°31'18.5"
15YP13	Volcaniclastic sandstone in Maastrichian (?) flysch, Yenipazar section, 5m below the disconformity	N40°10'01.7" E30°31'18.5"
15YP04	Lower Jurassic sandstone, base of the Tethyan series, South of Yenipazar	N40°06'06.0" E30°37'02.3"

Murdunu-Goynuk Basin

Samples	Description	Location
15GO02	First conglomeratic bed in late cretaceous flysch, Gojnuk section	N40°24'21.6" E30°47'00.5"
15GO01	First volcaniclastic bed in Campanian flysch, Gojnuk section	N40°23'46.2" E30°46'50.8"

Orhaniye Basin

Samples	Description	Location
15KZ01	Permian metasandstone, metamorphosed basement of Ohranyie area	N40°11'10.6" E32°33'32.7"

Appendix 3: U-Pb Analytical Parameters

Laboratory & Sample Preparation	
Laboratory name	KU Geology Isotope Geochemistry Laboratories
Sample type/mineral	Zircon
Sample preparation	Standard mineral separation & epoxy grain mount
Laser Ablation System	
Make, Model & type	ArF excimer 193 nm, Photon Machines Analyte G2, ATLEX 300
Ablation cell & volume	Helex 2, two-volume cell
Laser Wavelength (nm)	193
Pulse width	5 ns
Fluence	2 J/cm^2
Repetition rate	10 Hz
Spot Diameter (nominal/actual)	20/20 µm
Sampling mode/pattern	Single spot
Carrier gas (1/min)	He, 1.01 (cell); Ar, 1.1
Ablation duration (secs)	26 (long method)

ICP-MS Instrument	
Make, Model & type	Thermo Element2 magnetic sector field ICP-MS
Sample introduction	Ablation aerosol
RF power	1100 W
Make-up gas flow	Ar, 1.1/min
Sampling depth	20 µm
Detection system	Single detector, counting & analog
Masses measured	^{206}Pb, ^{207}Pb, ^{208}Pb, ^{232}Th, ^{238}U
Integration time per peak (ms)	1-5 (long)
Total integration time per reading (secs)	23 (long)
Total method time (secs)	42 (long)
Sensitivity/Efficiency	~0.1% U, GJ-1
IC Dead time (ns)	2 ns
UO+/U+(%)	< 0.01
^{238}U+/ ^{232}Th+	> 0.6

Data Processing	
Gas blank (s)	21 (long)
Calibration strategy	Sample/ standard bracketing. GJ-1 used as primary calibration standard. Plešovice and Fish Canyon Tuff used as secondary reference materials.
Reference Material info	GJ-1 (Jackson et al., 2004) Plešovice (Sláma et al., 2008) Fish Canyon Tuff (Wotzlaw et al., 2013)
Data processing package used	ET_Redux-3.6.14, IGOR PRO, Iolite 2.5
Mass discrimination	Y-Intercept, Downhole
Common-Pb correction, composition and uncertainty	No common-Pb correction applied to the data
Uncertainty level & propagation	Age uncertainties at ±2σ absolute, propagation is by quadratic addition following McLean et al., 2016, Paton et al., 2010
Reproducibility	See Appendix 2
Quality control/ Validation	Plešovice and Fish Canyon Tuff used as secondary reference materials.

Appendix 4: U-Pb Standard Values

Sample	Secondary Standard$_1$	Secondary Standard$_2$
	Plešovice	**Fish Canyon Tuff**
15YP08	341.2 ±3.2 Ma (MSWD=0.55)	28.85 ±0.65 Ma (MSWD=0.53)
15YP09	341.2 ±3.2 Ma (MSWD=0.55)	28.85 ±0.65 Ma (MSWD=0.53)
15G002	340.0 ±3.9 Ma (MSWD=1.3)	27.39 ±0.59 Ma (MSWD=1.6)
15YP04	347.2 ±3.4 Ma (MSWD=1.0)	28.66 ±0.50 Ma (MSWD=1.2)
15YP07	341.2 ±3.5 Ma (MSWD=0.40)	28.07 ±0.55 Ma (MSWD=0.88)
15YP11	341.2 ±3.5 Ma (MSWD=0.40)	28.07 ±0.55 Ma (MSWD=0.88)
15KZ01	341.1 ±8.5 Ma (MSWD=0.96)	29.4 ±1.2 Ma (MSWD=1.2)
15G001	337.2 ±8.5 Ma (MSWD=0.46)	28.29 ±0.97 Ma (MSWD=0.69)
15YP12	343.2 ±1.1 Ma (MSWD=1.3)	28.69 ±0.19 Ma (MSWD=2.6)
15YP13	343.2 ±1.1 Ma (MSWD=1.3)	28.69 ±0.19 Ma (MSWD=2.6)
15YP14	341.9 ±3.8 Ma (MSWD=0.65)	27.90 ±0.59 Ma (MSWD=1.8)
Reference age by CA-TIMS	**337.2 ±0.13 Ma (Sláma et al., 2008)**	**28.642 ±0.025 Ma (Wotzlaw et al., 2013)**

Appendix 5: LA-ICP-MS Zircon Data Tables

Table 1: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP09 & 15YP08: SGT FW Terrigenous Clastics

Sample-Grain #	Dates (Ma) 206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	Isotopic Ratios 206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP09																
15YP09-090	79.06981	3.64876	82.56557	7.28962	184.90085	175.77694	0.01234	4.64428	0.08471	9.22578	0.04981	7.97156	0.00366	8.99545	0.44771	57.23664
15YP09-143	79.10732	3.73745	81.55198	7.90671	153.75834	197.04973	0.01235	4.75495	0.08363	10.12925	0.04915	8.94383	0.00371	11.08110	0.38377	48.55087
15YP09-137	79.45905	7.83306	87.25577	16.05067	306.16338	339.79206	0.01240	9.92489	0.08973	19.34919	0.05250	16.60987	0.00376	13.85580	0.45005	74.04685
15YP09-106	80.25811	3.36707	78.90409	7.40387	38.09113	198.78885	0.01253	4.22257	0.08081	9.78833	0.04680	8.83070	0.00370	15.44687	0.37316	-110.70023
15YP09-150	80.27046	3.12065	85.18596	7.08125	225.24282	170.27039	0.01253	3.91287	0.08752	8.69656	0.05068	7.76657	0.00339	9.76220	0.35395	64.36270
15YP09-041	80.55834	2.84141	89.96667	7.21527	347.30241	163.79646	0.01258	3.55002	0.09265	8.41032	0.05346	7.62437	0.00341	8.35138	0.33724	76.80456
15YP09-133	80.55881	3.36101	85.73687	8.45057	232.43453	204.22567	0.01258	4.19933	0.08811	10.32127	0.05084	9.42838	0.00385	15.20570	0.28768	65.34129
15YP09-138	80.84181	3.91500	86.41838	7.45572	243.34113	166.36880	0.01262	4.87470	0.08884	9.03294	0.05108	7.60469	0.00384	12.29168	0.47155	66.77840
15YP09-112	81.83294	2.79335	80.65770	5.63425	45.98631	146.78736	0.01278	3.43593	0.08268	7.28669	0.04696	6.42575	0.00340	10.47897	0.39863	-77.95065
15YP09-149	83.27155	3.12969	86.53710	6.27017	177.58548	146.42575	0.01300	3.78366	0.08896	7.58218	0.04965	6.57064	0.00387	13.72617	0.43003	53.10903
15YP09-080	83.48479	5.21820	81.15547	8.80636	13.11853	212.46552	0.01303	6.29359	0.08321	11.33975	0.04632	9.43296	0.00445	13.44186	0.51054	-536.38812
15YP09-135	85.91825	5.79016	90.08119	8.72872	201.81431	166.93394	0.01342	6.78721	0.09277	10.16967	0.05017	7.57337	0.00369	12.97393	0.64425	57.42708
15YP09-074	87.27612	5.61618	97.07162	10.80145	344.91532	207.24030	0.01363	6.48144	0.10032	11.72995	0.05340	9.77663	0.00472	10.68551	0.51098	74.69636
15YP09-070	89.08373	6.35287	89.25047	10.64198	93.71182	226.42179	0.01392	7.18427	0.09188	12.52094	0.04791	10.25476	0.00604	17.33925	0.53528	4.93864
15YP09-015	115.28631	5.23329	113.99788	12.40887	87.17829	234.47338	0.01804	4.58196	0.11882	11.57826	0.04778	10.63305	0.00501	9.46004	0.31145	-32.24199
15YP09-053	210.11249	10.50651	218.69387	18.36415	312.09267	171.00404	0.03313	5.08650	0.24033	9.41884	0.05264	7.92730	0.00933	19.25368	0.48447	32.67625
15YP09-140	234.42113	8.84888	240.31143	18.40040	298.27598	168.34661	0.03703	3.84647	0.26702	8.67707	0.05232	7.77793	0.00973	6.62762	0.38610	21.40798
15YP09-048	241.38813	8.81175	244.36253	15.71166	273.03455	137.64237	0.03816	3.72176	0.27209	7.29059	0.05174	6.26907	0.01150	8.36246	0.43850	11.59063
15YP09-001	249.81822	12.01861	257.29586	17.60171	325.99308	132.35612	0.03951	4.90934	0.28840	7.81187	0.05296	6.07649	0.01132	7.30699	0.60286	23.36702
15YP09-104	258.61241	9.40139	265.05106	21.16319	322.34789	179.96915	0.04093	3.71143	0.29827	9.16719	0.05287	8.38228	0.01134	7.38799	0.31426	19.77227
15YP09-066	294.95622	17.22313	302.98201	21.28329	365.25973	122.03455	0.04682	5.98181	0.34769	8.21044	0.05389	5.62400	0.01532	10.38964	0.69237	19.24754
15YP09-105	309.80309	10.87472	309.63547	15.28933	308.37335	99.64500	0.04923	3.59826	0.35655	5.77229	0.05255	4.51352	0.01390	8.43538	0.58533	-0.46364
15YP09-110	313.41298	15.42040	321.74637	31.64926	382.51423	220.33198	0.04982	5.04676	0.37283	11.65811	0.05430	10.50913	0.01573	15.43012	0.34653	18.06501
15YP09-117	314.26502	10.34209	315.76049	19.97152	326.81212	143.69829	0.04996	3.37445	0.36476	7.43208	0.05298	6.62185	0.01304	9.28805	0.38574	3.83924
15YP09-129	315.91013	11.54265	326.97994	20.15335	406.55225	133.95911	0.05023	3.74739	0.37992	7.28107	0.05489	6.24268	0.01357	9.52619	0.46564	22.29532
15YP09-084	323.74517	13.36509	321.70359	17.16923	306.94974	102.27051	0.05150	4.23719	0.37277	6.27994	0.05252	4.63507	0.01480	5.71070	0.65924	-5.47172
15YP09-065	324.18131	23.46002	313.61304	27.35697	235.78824	155.98259	0.05157	7.43370	0.36187	10.27735	0.05091	7.09676	0.01607	10.98385	0.70933	-37.48833
15YP09-114	324.65198	11.90604	325.78041	23.51900	333.85196	164.97185	0.05165	3.76392	0.37829	8.53774	0.05314	7.66328	0.01276	9.88403	0.34670	2.75571
15YP09-134	330.59005	12.28097	323.06359	18.96467	269.16054	127.21818	0.05262	3.81457	0.37461	6.91797	0.05166	5.77126	0.01268	9.45742	0.50185	-22.82263
15YP09-006	331.10503	12.95082	325.19036	17.12435	283.05808	104.76271	0.05270	4.01674	0.37749	6.20631	0.05197	4.73119	0.01468	6.20525	0.62542	-16.97424
15YP09-003	331.29346	13.88130	332.95268	19.50154	344.56182	118.60891	0.05274	4.30325	0.38806	6.93624	0.05339	5.43999	0.01519	11.48252	0.58688	3.85079
15YP09-002	332.52239	14.89168	322.14552	17.73182	247.78933	101.80179	0.05294	4.60021	0.37337	6.47996	0.05118	4.56376	0.01456	7.13027	0.69428	-34.19560
15YP09-012	332.91973	16.36886	324.54833	25.23273	264.91777	167.42192	0.05300	5.05122	0.37662	9.19713	0.05156	7.68585	0.01391	11.92170	0.49612	-25.66908
15YP09-017	339.12624	10.40815	344.08506	12.97573	377.71065	69.87618	0.05402	3.15309	0.40336	4.47459	0.05418	3.17489	0.01486	5.75113	0.68367	10.21534
15YP09-087	343.94533	12.97053	340.14279	15.23055	314.23584	80.48585	0.05480	3.87650	0.39793	5.30920	0.05268	3.62772	0.01580	6.51835	0.71615	-9.45452
15YP09-081	344.21097	34.84557	361.17705	45.50331	471.63873	230.67350	0.05485	10.42414	0.42719	15.31242	0.05651	11.21639	0.03477	12.29437	0.65960	27.01809
15YP09-077	345.93600	37.77409	355.48746	36.48323	418.33216	111.79791	0.05513	11.24791	0.41921	12.38518	0.05518	5.18432	0.01750	7.03581	0.90731	17.30590
15YP09-100	364.55552	14.27445	364.60065	18.27098	364.88773	97.71716	0.05818	4.03180	0.43201	6.01866	0.05388	4.46865	0.01589	6.95395	0.64786	0.09105
15YP09-086	381.75337	20.16166	389.34111	24.54731	434.67508	116.32976	0.06101	5.44777	0.46733	7.68316	0.05558	5.41783	0.01864	7.78872	0.69283	12.17501
15YP09-069	385.52125	27.65797	414.61196	40.35223	579.90713	195.14206	0.06163	7.40671	0.50430	12.09313	0.05938	9.55952	0.02292	16.36218	0.58303	33.52017
15YP09-026	387.36802	20.40220	372.04170	25.47603	277.65577	137.10811	0.06193	5.43530	0.44254	8.28203	0.05185	6.24896	0.01466	10.94110	0.63908	-39.51376
15YP09-098	388.66827	14.05214	394.86372	19.56183	431.30181	102.45481	0.06215	3.72961	0.47533	6.03759	0.05550	4.74790	0.01680	6.60319	0.59954	9.88485
15YP09-027	390.75060	11.83271	393.47638	14.97664	409.52629	74.54251	0.06249	3.12377	0.47332	4.62526	0.05496	3.41103	0.01633	7.02480	0.64787	4.58473
15YP09-094	390.79687	15.48801	397.94546	21.04759	439.67850	107.57203	0.06250	4.08944	0.47981	6.45975	0.05571	5.00048	0.01881	10.68625	0.59664	11.11758
15YP09-052	392.08817	12.54933	397.54196	15.56945	429.37553	74.93589	0.06271	3.30218	0.47923	4.76948	0.05545	3.44145	0.01731	6.60657	0.66563	8.68409
15YP09-037	392.85598	13.83155	400.10521	18.02959	442.19032	89.33051	0.06284	3.63304	0.48297	5.50088	0.05577	4.13047	0.02657	8.14783	0.63855	11.15681
15YP09-063	394.66627	16.35613	406.96204	20.19631	477.34213	92.87667	0.06314	4.27787	0.49301	6.08378	0.05666	4.32575	0.02113	10.33497	0.68474	17.32004
15YP09-047	395.73910	12.27219	393.10494	16.41597	377.63880	86.30807	0.06331	3.20029	0.47278	5.07730	0.05418	3.94172	0.01685	7.30257	0.60062	-4.79302
15YP09-101	395.78206	16.01062	395.40230	16.60316	393.18248	64.79144	0.06332	4.17595	0.47611	5.11124	0.05456	2.94724	0.01857	5.86651	0.81252	-0.66117
15YP09-145	397.13118	13.72451	399.53247	16.02819	413.44552	73.11100	0.06354	3.56725	0.48213	4.89113	0.05505	3.34633	0.01679	6.43310	0.71848	3.94595
15YP09-025	399.02622	14.18242	399.17302	15.36678	400.02299	64.18869	0.06385	3.66943	0.48160	4.69121	0.05473	2.92280	0.01691	6.00761	0.77271	0.24918
15YP09-124	399.22073	14.85423	402.49666	16.63588	421.34345	71.47115	0.06389	3.84163	0.48646	5.04758	0.05525	3.27413	0.01629	5.59300	0.75106	5.25052
15YP09-030	399.48139	13.54338	403.83627	16.23175	428.82290	75.00714	0.06393	3.50005	0.48842	4.91067	0.05544	3.44447	0.01646	7.58345	0.69541	6.84234
15YP09-099	399.81636	13.98876	402.42385	17.13828	417.42078	81.51206	0.06399	3.61234	0.48636	5.20207	0.05515	3.74334	0.01877	6.47875	0.67767	4.21743
15YP09-141	400.49823	13.82466	390.45385	17.41391	331.37509	90.00620	0.06410	3.56402	0.46894	5.41857	0.05308	4.08150	0.01682	8.99776	0.62761	-20.85948
15YP09-079	400.68341	22.97745	394.71460	24.56293	359.89971	104.04002	0.06413	5.92518	0.47511	7.60225	0.05376	4.76303	0.02212	14.69032	0.77285	-11.33196
15YP09-024	403.09213	16.68046	398.26071	18.23496	370.31750	78.99809	0.06453	4.27438	0.48027	5.58513	0.05401	3.59491	0.01686	11.17885	0.75814	-8.85041
15YP09-016	410.93587	12.88722	410.23291	14.79105	406.27906	65.74755	0.06582	3.24032	0.49783	4.41486	0.05488	2.99855	0.01807	8.66927	0.71561	-1.14621
15YP09-060	411.21292	22.01656	407.74293	22.53773	388.13907	85.79811	0.06587	5.53608	0.49416	6.78637	0.05444	3.92512	0.01930	7.41317	0.81252	-5.94474
15YP09-009	418.37505	18.14858	397.93333	19.50544	280.85792	88.10814	0.06705	4.48647	0.47980	5.98203	0.05192	3.95680	0.01698	10.22422	0.74052	-48.96323
15YP09-013	450.06813	12.83397	441.70850	14.96070	398.38237	65.77170	0.07231	2.95520	0.54499	4.20788	0.05469	2.99550	0.01886	5.71722	0.67888	-12.97391
15YP09-008	475.88814	15.25183	475.26847	21.37837	472.27856	99.04137	0.07662	3.32861	0.59691	5.69243	0.05653	4.61781	0.02149	9.37276	0.54024	-0.76429
15YP09-062	494.96050	19.58149	490.19623	22.38102	467.99336	88.60620	0.07981	4.11624	0.62056	5.82007	0.05642	4.11457	0.02138	13.86572	0.68777	-5.76229
15YP09-007	512.00058	46.99004	495.69137	53.51211	421.04898	213.29269	0.08266	9.58190	0.62935	14.01000	0.05524	10.22092	0.01925	16.58013	0.63807	-21.60119
15YP09-142	536.03324	20.81878	551.62019	33.10927	616.50708	140.19207	0.08671	4.05412	0.72162	7.90769	0.06039	6.78939	0.02262	7.89636	0.45112	13.05319
15YP09-068	537.26073	28.59410	552.65077	33.85893	616.58461	121.74369	0.08691	5.55938	0.72336	8.07839	0.06039	5.86119	0.02963	5.98498	0.67788	12.86504
15YP09-043	539.30544	19.35003	546.20491	27.38846	575.09335	113.25603	0.08726	3.74575	0.71246	6.57156	0.05924	5.39952	0.02676	9.43984	0.49333	6.22297
15YP09-044	543.33093	17.60408	537.86884	25.56396	514.77728	110.22230	0.08794	3.38311	0.69846	6.20000	0.05763	5.19563	0.02473	7.71746	0.49229	-5.54680
15YP09-096	556.03612	23.03339	581.67326	33.32941	683.08476	129.25378	0.09008	4.33138	0.77333	7.65189	0.06229	6.30797	0.02786	8.59903	0.51349	18.59925
15YP09-078	573.44281	32.87961	569.84238	35.26317	555.50241	118.14198	0.09303	6.00783	0.75279	8.22830	0.05871	5.62236	0.03075	7.86992	0.72190	-3.22958

Table 1 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP09 & 15YP08: SGT FW Terrigenous Clastics

Sample-Grain #	Dates (Ma) 206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	Isotopic Ratios 206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP09																
15YP09-019	585.83730	17.70922	606.60388	24.48640	684.96281	91.38449	0.09514	3.16667	0.81741	5.42693	0.06234	4.40724	0.02801	7.98869	0.51738	14.47166
15YP09-035	595.83561	20.34651	597.99803	27.19947	606.20723	103.36131	0.09684	3.58068	0.80207	6.09984	0.06010	4.93830	0.02495	6.29192	0.00000	1.71090
15YP09-139	602.28376	20.96364	602.22265	22.31468	601.99263	71.23363	0.09793	3.65176	0.80959	4.96658	0.05998	3.36624	0.02553	4.70872	0.71402	-0.04836
15YP09-058	604.41981	26.27750	599.38833	26.44295	580.39945	79.79472	0.09830	4.56385	0.80454	5.91787	0.05939	3.76728	0.03059	15.12231	0.76156	-4.13859
15YP09-125	606.14098	20.30604	608.12898	33.83491	615.54270	137.40640	0.09859	3.51555	0.82014	7.51980	0.06036	6.64743	0.02762	12.57538	0.39297	1.52739
15YP09-144	608.93279	21.12091	609.25162	24.79195	610.43734	86.08161	0.09907	3.64087	0.82216	5.47803	0.06022	4.09302	0.02491	15.18388	0.64252	0.24647
15YP09-021	612.67899	19.98875	611.84370	27.43839	608.75281	104.35133	0.09970	3.42532	0.82682	6.05196	0.06017	4.98933	0.02665	6.34901	0.52178	-0.64495
15YP09-005	629.97201	27.12694	638.98881	31.16587	671.00239	101.53895	0.10266	4.52941	0.87631	6.67387	0.06194	4.90153	0.02876	8.56187	0.65696	6.11479
15YP09-046	636.10708	19.12028	623.23905	19.55528	576.79578	60.23420	0.10371	3.16125	0.84743	4.23922	0.05929	2.82444	0.02836	6.55757	0.72909	-10.28289
15YP09-076	641.69038	35.91191	657.48396	37.85022	712.05017	109.97597	0.10467	5.89602	0.91080	7.96801	0.06314	5.35967	0.03417	8.91523	0.73467	9.88130
15YP09-029	644.08353	22.25804	646.28636	26.55299	653.98994	89.53650	0.10508	3.63756	0.88985	5.62712	0.06145	4.29333	0.02530	7.39197	0.61332	1.51476
15YP09-056	651.56128	31.22008	686.77957	37.88413	803.92950	118.08292	0.10636	5.05003	0.96674	7.73380	0.06595	5.85737	0.03020	9.96882	0.61317	18.95293
15YP09-042	654.39142	20.72267	636.06417	31.41191	571.47405	122.78060	0.10684	3.33552	0.87092	6.74959	0.05915	5.86782	0.02951	7.66700	0.43718	-14.50939
15YP09-119	667.14530	40.06606	658.46548	58.98584	628.84594	217.30815	0.10904	6.34141	0.91265	12.53501	0.06073	10.81264	0.03122	19.65221	0.42205	-6.09042
15YP09-073	668.63090	79.55010	671.32788	68.91240	680.38912	146.85834	0.10929	12.60274	0.93703	14.51679	0.06221	7.20473	0.03643	9.19456	0.86733	1.72816
15YP09-127	668.78598	21.61154	667.94082	28.15531	665.09036	98.27237	0.10932	3.40769	0.93058	5.83310	0.06177	4.73420	0.02729	6.24429	0.53635	-0.55566
15YP09-130	675.42587	28.29695	684.04986	46.43316	712.52505	170.22053	0.11046	4.42251	0.96145	9.54587	0.06316	8.45962	0.03009	10.53298	0.34426	5.20672
15YP09-108	680.62216	22.86620	664.92480	29.57787	612.06489	105.05087	0.11136	3.54636	0.92486	6.15180	0.06026	5.02672	0.03026	7.40209	0.54203	-11.20098
15YP09-064	697.72492	47.55129	723.56859	43.97521	804.51893	98.01170	0.11431	7.21725	1.03930	8.68474	0.06597	4.83073	0.03466	6.99156	0.82897	13.27427
15YP09-059	700.39870	32.24824	721.25077	35.30767	786.65452	101.01251	0.11477	4.87110	1.03465	6.95838	0.06541	4.96905	0.03262	7.04742	0.67537	10.96489
15YP09-075	702.22108	35.61637	708.01039	34.17073	726.41632	86.66205	0.11509	5.36804	1.00829	6.81700	0.06357	4.20186	0.03747	6.61450	0.77964	3.33077
15YP09-055	710.75938	28.32104	706.28933	31.89517	692.10069	98.54599	0.11656	4.21758	1.00489	6.36658	0.06255	4.76921	0.03164	10.28170	0.62224	-2.69595
15YP09-072	711.15138	37.95264	682.95152	35.59030	591.09740	96.65114	0.11663	5.65319	0.95933	7.28574	0.05968	4.59602	0.08869	15.34944	0.77196	-20.31035
15YP09-014	761.40086	26.55404	785.64736	33.73019	855.12352	101.67088	0.12537	3.70516	1.16787	6.26991	0.06759	5.05802	0.03519	8.51632	0.51246	10.96013
15YP09-049	774.24983	26.11034	804.41245	31.16415	888.86232	88.85306	0.12762	3.58617	1.20831	5.69626	0.06870	4.42569	0.03691	8.12993	0.58760	12.89429
15YP09-033	800.48993	33.74354	796.68881	44.27579	786.07054	137.72735	0.13222	4.49425	1.19157	8.19738	0.06539	6.85556	0.03673	8.14329	0.48680	-1.83436
15YP09-136	813.41075	32.89945	778.45239	28.66439	679.48313	66.05182	0.13449	4.31617	1.15256	5.34747	0.06218	3.15692	0.03530	6.49833	0.79656	-19.71022
15YP09-032	834.81738	35.44655	879.81720	48.17645	994.78652	137.00859	0.13826	4.53936	1.37854	8.38377	0.07235	7.04853	0.03731	8.93835	0.47732	16.08075
15YP09-122	836.06492	54.48884	821.11447	101.22617	780.83217	331.42150	0.13848	6.97851	1.24493	18.90377	0.06523	17.56852	0.04130	16.83719	0.22718	-7.07358
15YP09-131	865.23160	31.87276	893.43985	36.86373	963.90580	97.62312	0.14364	3.94622	1.41067	6.31814	0.07126	4.93420	0.04095	7.01955	0.57367	10.23691
15YP09-093	917.83904	64.61887	950.63120	62.03769	1027.34106	136.48584	0.15301	7.59140	1.55035	10.36408	0.07352	7.05584	0.04182	8.35736	0.71689	10.65878
15YP09-083	921.28711	37.63859	926.66138	35.19268	939.47157	78.38794	0.15363	4.39715	1.49085	5.89229	0.07041	3.92228	0.04596	6.37697	0.74034	1.93561
15YP09-051	935.85605	37.05265	947.90929	32.51887	976.00622	64.87284	0.15624	4.26581	1.54352	5.36292	0.07168	3.25019	0.04859	6.01891	0.78646	4.11372
15YP09-036	942.56026	28.20248	971.00041	37.58215	1035.92759	101.75375	0.15744	3.22323	1.60202	6.12429	0.07383	5.20747	0.04249	9.12595	0.43208	9.01292
15YP09-095	954.33709	44.79630	994.75027	55.33828	1084.95831	141.63135	0.15956	5.06758	1.66360	8.96817	0.07565	7.39917	0.04960	12.55146	0.46885	12.03928
15YP09-115	957.25324	38.47238	954.19762	47.34338	947.15843	128.12064	0.16009	4.33775	1.55932	7.83399	0.07068	6.52344	0.04148	7.95995	0.48082	-1.06580
15YP09-116	964.33704	38.48593	986.81253	58.03528	1037.13919	161.37592	0.16136	4.30972	1.64286	9.46250	0.07387	8.42409	0.03867	11.20254	0.36715	7.01952
15YP09-031	976.55810	37.07498	979.88924	32.97410	987.36148	67.78533	0.16357	4.10310	1.62490	5.33212	0.07208	3.40529	0.04258	6.19208	0.75270	1.09417
15YP09-128	983.32143	29.54122	988.11425	27.97281	998.77359	61.74903	0.16479	3.24661	1.64625	4.48990	0.07249	3.10141	0.04373	5.17936	0.69708	1.54711
15YP09-111	991.49164	32.44636	989.43773	30.87678	984.88570	69.14083	0.16626	3.53949	1.64970	4.95922	0.07199	3.47360	0.04204	7.83173	0.69405	-0.67073
15YP09-050	1004.61489	32.32290	1028.46240	28.33029	1079.54281	54.36970	0.16864	3.48338	1.75352	4.44295	0.07545	2.75787	0.04289	5.51845	0.77311	6.94071
15YP09-071	1005.93646	56.64450	1027.09244	52.33627	1072.43720	109.27429	0.16888	6.10859	1.74981	8.31238	0.07518	5.63744	0.06147	9.33133	0.72408	6.20090
15YP09-057	1006.34609	43.02666	996.11277	38.43936	973.65050	81.00309	0.16895	4.63338	1.66718	6.17252	0.07160	4.07821	0.04588	5.71403	0.73794	-3.35804
15YP09-045	1015.60636	30.37513	1011.80345	26.44595	1003.57969	52.78619	0.17063	3.24025	1.70872	4.18303	0.07266	2.64548	0.04450	6.24785	0.76443	-1.19838
15YP09-022	1022.57137	31.34316	1039.03279	30.61365	1073.82856	67.46466	0.17190	3.32273	1.78234	4.77825	0.07523	3.43381	0.04637	4.87168	0.67120	4.77331
15YP09-082	1048.29417	37.26078	1040.01814	33.08194	1022.66556	67.94737	0.17659	3.86241	1.78504	5.16700	0.07335	3.43216	0.05393	4.96899	0.73953	-2.50606
15YP09-092	1066.81462	40.95621	1050.18102	36.31049	1015.74807	75.15033	0.17997	4.17880	1.81305	5.64882	0.07310	3.80090	0.05049	6.27673	0.71616	-5.02748
15YP09-148	1131.90108	39.98923	1135.29432	41.32835	1141.78728	92.81630	0.19194	3.86414	2.05902	6.17175	0.07784	4.81237	0.04815	6.44210	0.57813	0.86585
15YP09-088	1144.81307	42.70445	1147.18582	40.21673	1151.67396	84.05559	0.19433	4.08480	2.09506	5.96869	0.07822	4.35197	0.05893	7.40133	0.64789	0.59573
15YP09-054	1300.16513	68.25122	1412.57311	52.98374	1586.43036	74.91346	0.22347	5.82738	3.01956	7.13063	0.09804	4.10944	0.04189	20.29843	0.81211	18.04461
15YP09-123	1502.08418	53.16124	1495.57816	37.93854	1486.36899	54.32059	0.26240	3.98390	3.36195	4.93945	0.09297	2.92005	0.06351	8.92594	0.80029	-1.05729
15YP09-011	1781.64595	62.97645	1836.70419	41.63137	1899.68309	51.57291	0.31835	4.06549	5.10360	5.00534	0.11632	2.91980	0.08176	6.82680	0.79775	6.21352
15YP09-061	1811.62345	99.40445	1799.76040	62.84798	1786.04373	77.26179	0.32449	6.34289	4.88551	7.69211	0.10924	4.35159	0.09207	6.82824	0.81984	-1.43220
15YP09-020	1843.93701	59.85579	1881.35573	46.59606	1922.92213	72.02158	0.33115	3.74983	5.37799	5.56911	0.11784	4.11750	0.08231	6.74798	0.61974	4.10756
15YP09-097	1966.47288	64.05685	1988.56604	41.79277	2011.61149	53.69815	0.35669	3.79835	6.08826	4.89200	0.12385	3.08288	0.09682	5.99328	0.76006	2.24390
15YP09-018	1998.90111	54.56620	2042.31732	45.47833	2086.45385	72.39243	0.36353	3.18835	6.47360	5.28836	0.12921	4.21914	0.09025	5.62476	0.53824	4.19625
15YP09-102	2044.19775	84.54028	2039.51978	47.45158	2034.79182	45.86782	0.37315	4.85772	6.45303	5.52557	0.12548	2.63335	0.09005	4.09468	0.87749	-0.46226
15YP09-120	2110.32368	53.84062	2116.62804	32.40148	2122.75872	37.44284	0.38731	3.00417	7.04106	3.70304	0.13191	2.16505	0.08958	4.38316	0.80462	0.58580
15YP09-004	2257.16366	71.72423	2238.18956	39.04286	2220.87908	38.50587	0.41927	3.78737	8.06373	4.40615	0.13955	2.25166	0.10414	5.52044	0.85612	-1.63379
15YP09-107	2417.24465	97.58743	2479.84911	53.83990	2531.55052	56.46078	0.45496	4.87807	10.49922	5.96418	0.16745	3.43160	0.10631	7.11443	0.81246	4.51525
15YP09-103	2425.37918	70.13217	2520.01265	37.82788	2597.13883	36.75583	0.45679	3.48853	10.96319	4.14197	0.17414	2.23295	0.11054	4.59532	0.83578	6.61342
15YP09-091	2563.82093	90.57631	2667.68130	48.52443	2747.38968	49.12774	0.48842	4.31206	12.83589	5.27631	0.19069	3.04065	0.13540	5.11636	0.81386	6.68157
15YP09-109	2564.89684	62.22547	2619.69521	33.88949	2662.32241	35.67890	0.48866	2.95484	12.19723	3.67218	0.18111	2.18034	0.11698	8.05967	0.78554	3.65942
15YP09-010	2818.34351	80.97505	2853.11209	45.11536	2877.75968	52.01084	0.54836	3.56920	15.60805	4.83447	0.20653	3.26081	0.12596	6.05029	0.70137	2.06467
15YP09-085	3251.58026	94.47095	3259.12351	44.55778	3263.76762	43.71109	0.65599	3.72671	23.77284	4.67468	0.26295	2.82211	0.16774	6.08310	0.78263	0.37341
15YP09-028	3486.85421	82.75687	3567.59985	35.12855	3613.24847	28.78959	0.71755	3.09267	32.56724	3.62827	0.32932	1.89728	0.16008	4.91753	0.84786	3.49808

Table 1 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP09 & 15YP08: SGT FW Terrigenous Clastics

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP08																
15YP08-090	161.10542	6.20448	196.28314	8.78691	643.41521	63.98589	0.02531	3.90139	0.21326	4.94464	0.06115	3.03785	0.00671	6.17077	0.76833	74.96089
15YP08-091	241.62969	12.06067	266.45178	26.28941	490.74034	209.66616	0.03819	5.09028	0.30007	11.36407	0.05700	10.16027	0.01018	11.84539	0.35909	50.76221
15YP08-064	275.34817	10.78742	274.20709	13.19245	264.47954	85.09956	0.04364	4.00535	0.31003	5.52578	0.05155	3.80675	0.01173	5.05514	0.71192	-4.10944
15YP08-143	285.03048	11.26910	270.02185	20.19730	141.81935	169.15044	0.04521	4.04523	0.30465	8.60376	0.04890	7.59347	0.01207	12.59813	0.37980	-100.98137
15YP08-088	285.28249	10.65085	280.60326	13.36007	241.78231	88.28352	0.04525	3.81982	0.31831	5.48535	0.05104	3.93676	0.01248	5.12332	0.67185	-17.99147
15YP08-049	305.24907	13.40924	313.36643	15.55906	374.19321	80.77106	0.04849	4.50239	0.36154	5.81509	0.05410	3.68018	0.01248	9.94625	0.76514	18.42474
15YP08-017	309.94517	10.39736	314.46357	15.61316	348.08845	102.77217	0.04925	3.43864	0.36302	5.81808	0.05348	4.69317	0.01388	8.14189	0.55731	10.95793
15YP08-055	315.30836	11.55210	328.75928	16.17876	425.10678	95.84255	0.05013	3.75744	0.38234	5.80689	0.05534	4.42737	0.01315	8.02385	0.60864	25.82843
15YP08-015	317.79495	12.48146	325.31254	14.21696	379.46741	70.33901	0.05053	4.02903	0.37766	5.14357	0.05423	3.19738	0.01379	6.53257	0.77262	16.25237
15YP08-112	326.36683	12.51611	339.70613	18.45028	432.02938	109.94475	0.05193	3.93670	0.39732	6.44876	0.05552	5.10773	0.01530	8.03460	0.57574	24.45726
15YP08-019	328.53804	12.01895	333.66128	15.01905	369.53431	82.72836	0.05229	3.75583	0.38903	5.32055	0.05399	3.76855	0.01367	6.36742	0.67843	11.09404
15YP08-036	333.44809	19.16390	328.56750	22.94248	294.13889	126.92322	0.05309	5.90589	0.38208	8.26618	0.05222	5.78362	0.01630	8.95130	0.69705	-13.36417
15YP08-052	335.02939	15.82327	316.81606	25.58134	184.92572	180.31735	0.05335	4.85269	0.36618	9.51901	0.04981	8.18919	0.01408	9.69550	0.44270	-81.16971
15YP08-042	335.57089	16.34776	336.41034	18.68480	342.21733	94.05494	0.05343	5.00587	0.39280	6.58538	0.05334	4.27884	0.01547	7.21406	0.75117	1.94217
15YP08-077	336.30005	15.29538	337.37716	25.47046	344.80758	164.88809	0.05355	4.67334	0.39412	8.98533	0.05340	7.67438	0.01345	13.72064	0.48261	2.46733
15YP08-140	344.77569	11.48308	343.55223	14.23668	335.28474	78.12387	0.05494	3.42350	0.40263	4.91887	0.05318	3.53199	0.01586	6.23416	0.67169	-2.83071
15YP08-142	351.24544	12.81936	337.52739	17.23980	244.06768	105.91004	0.05600	3.75375	0.39433	6.05481	0.05109	4.75079	0.01531	7.03367	0.59128	-43.91313
15YP08-061	361.35606	17.09102	384.17807	37.69408	524.07799	224.08956	0.05766	4.86994	0.45989	12.00601	0.05788	10.97397	0.02422	29.09453	0.29335	31.04918
15YP08-081	369.03013	23.70519	396.91343	45.31533	562.69984	250.47129	0.05892	6.62143	0.47831	14.10580	0.05891	12.45513	0.03111	19.90680	0.41098	34.41794
15YP08-006	377.34028	13.03232	386.48565	20.39503	441.61169	114.37092	0.06028	3.55940	0.46321	6.40906	0.05575	5.32980	0.01714	10.52104	0.49764	14.55383
15YP08-056	384.12261	14.41041	386.01301	15.19777	397.36106	61.30322	0.06140	3.86872	0.46253	4.76839	0.05466	2.78758	0.01719	8.97353	0.80248	3.33159
15YP08-087	387.25862	12.22812	395.11394	16.49776	441.33987	84.50806	0.06191	3.25649	0.47569	5.08156	0.05575	3.90096	0.01630	6.55792	0.61093	12.25388
15YP08-104	397.43717	16.48467	395.78360	25.26178	386.13632	140.22758	0.06359	4.28239	0.47667	7.80396	0.05439	6.52403	0.01681	8.45385	0.51584	-2.92665
15YP08-065	438.98375	15.33406	438.93269	18.48526	438.66493	82.05995	0.07047	3.61767	0.54077	5.23455	0.05568	3.78326	0.01777	7.57429	0.67546	-0.07268
15YP08-070	442.62967	15.20462	445.26123	20.97089	458.88125	100.53391	0.07108	3.55854	0.55040	5.87818	0.05619	4.67865	0.01922	7.90428	0.56814	3.54156
15YP08-145	449.56668	16.09789	451.24185	21.77407	459.78673	102.34830	0.07223	3.71170	0.55956	6.04128	0.05621	4.76658	0.01958	8.64105	0.58504	2.22278
15YP08-024	450.93154	16.46295	444.67392	19.12754	412.42421	82.75271	0.07246	3.78489	0.54951	5.36224	0.05503	3.79845	0.01982	6.76903	0.69018	-9.33683
15YP08-135	453.54303	14.47148	458.96992	18.22162	486.22888	80.10496	0.07289	3.30804	0.57148	4.97930	0.05689	3.72161	0.01873	6.26529	0.63480	6.72232
15YP08-082	455.53925	16.32929	458.73103	25.60616	474.74951	126.69099	0.07322	3.71746	0.57111	7.02570	0.05659	5.96163	0.01857	15.41278	0.47845	4.04640
15YP08-093	457.62707	16.25067	452.70050	18.06230	427.75802	73.34520	0.07357	3.68325	0.56180	4.98945	0.05541	3.36576	0.01875	7.43693	0.72337	-6.98270
15YP08-125	462.40185	15.44238	454.00549	17.10858	411.71321	69.89144	0.07437	3.46496	0.56381	4.71300	0.05501	3.19475	0.02091	7.69380	0.71819	-12.31164
15YP08-133	466.42604	17.69574	471.00888	21.46017	493.40053	89.93319	0.07504	3.93821	0.59022	5.75497	0.05707	4.19645	0.01916	8.43408	0.65801	5.46706
15YP08-010	475.45616	14.53130	467.06668	15.73406	426.03654	61.36145	0.07654	3.17396	0.58406	4.23540	0.05537	2.80439	0.02251	11.51947	0.73002	-11.59985
15YP08-107	482.23935	45.87039	463.63260	48.33627	372.48388	188.29920	0.07768	9.90738	0.57871	13.30033	0.05406	8.87369	0.02453	12.98612	0.73920	-29.46583
15YP08-083	524.61598	18.20475	551.12722	24.80186	662.25386	96.91058	0.08478	3.61833	0.72078	5.90326	0.06169	4.66435	0.02779	8.98349	0.57123	20.78325
15YP08-109	524.70564	23.81797	547.31674	33.18643	642.59279	132.21566	0.08480	4.73529	0.71433	7.97336	0.06112	6.41494	0.02717	7.59020	0.55376	18.34555
15YP08-121	544.86722	17.79773	556.13682	20.36993	602.54114	71.59596	0.08820	3.41113	0.72929	4.80497	0.06000	3.38407	0.02508	5.13193	0.68669	9.57178
15YP08-074	561.91351	22.01952	573.78275	32.10240	621.08213	128.60660	0.09108	4.09893	0.75961	7.44077	0.06052	6.20998	0.02308	7.58632	0.49449	9.52670
15YP08-003	583.56976	22.59185	602.68811	31.19899	675.26758	116.77747	0.09475	4.05629	0.81042	6.97059	0.06206	5.66883	0.02694	17.07870	0.54784	13.57948
15YP08-146	588.38871	19.29702	584.79234	22.99786	570.85329	83.60031	0.09557	3.43673	0.77879	5.23227	0.05913	3.94531	0.02474	7.66327	0.64121	-3.07179
15YP08-043	592.79911	27.20359	600.31604	44.55944	628.80983	179.51544	0.09632	4.81339	0.80619	10.05077	0.06073	8.82322	0.03035	10.81054	0.38690	5.72681
15YP08-062	594.45423	21.86702	601.54600	23.96360	628.36448	77.70910	0.09660	3.85725	0.80838	5.34233	0.06072	3.69622	0.02500	6.23454	0.70489	5.39659
15YP08-094	596.81479	23.97652	591.57804	32.22088	571.54177	124.69194	0.09700	4.21408	0.79072	7.30168	0.05915	5.96288	0.02665	6.95994	0.50954	-4.42190
15YP08-114	599.60619	26.20271	599.61559	29.80061	599.65110	101.78896	0.09748	4.58569	0.80495	6.67853	0.05992	4.85533	0.02775	6.35448	0.66049	0.00749
15YP08-101	604.56063	29.13895	580.91444	46.24963	489.50418	195.40556	0.09832	5.06083	0.77201	10.69672	0.05697	9.42379	0.02566	8.28262	0.41225	-23.50469
15YP08-085	604.78816	21.48252	624.24466	24.67358	695.40707	79.90624	0.09836	3.72751	0.84926	5.35607	0.06265	3.84618	0.02760	5.24859	0.66942	13.03106
15YP08-084	608.10220	24.42974	631.67758	40.32909	716.99099	154.85672	0.09892	4.21782	0.86285	8.74751	0.06329	7.66347	0.02591	7.82248	0.39856	15.18691
15YP08-122	609.69174	23.89460	599.96212	22.96184	563.36042	65.24302	0.09920	4.11500	0.80556	5.12637	0.05893	3.05718	0.02568	5.64978	0.79629	-8.22410
15YP08-037	610.94526	34.75840	602.50078	33.20776	570.85525	93.12295	0.09941	5.97924	0.81008	7.42847	0.05913	4.40805	0.02812	8.03458	0.80179	-7.02280
15YP08-089	615.98771	18.38756	603.77554	19.25907	558.19231	62.06134	0.10027	3.13441	0.81236	4.27196	0.05879	2.90261	0.02537	7.42916	0.71703	-10.35403
15YP08-030	618.36194	21.34063	616.94370	21.56214	611.74283	63.79050	0.10067	3.62532	0.83601	4.71350	0.06025	3.01233	0.03037	14.38222	0.76070	-1.08201
15YP08-002	619.39169	26.80096	611.63156	37.54515	582.99789	144.60125	0.10085	4.54763	0.82643	8.32480	0.05946	6.97290	0.02831	6.49480	0.48745	-6.24253
15YP08-124	621.45689	21.91839	649.50009	30.51212	748.21525	107.89693	0.10120	3.70597	0.89584	6.45589	0.06423	5.28624	0.02855	8.09735	0.49961	16.94143
15YP08-033	622.06822	21.61770	619.36174	21.70507	609.48348	63.74447	0.10131	3.65162	0.84039	4.73162	0.06019	3.00897	0.02789	4.17324	0.76462	-2.06482
15YP08-009	622.84676	20.57386	632.70146	20.92579	668.07275	59.83559	0.10144	3.47088	0.86473	4.49025	0.06185	2.84874	0.02659	5.75222	0.76727	6.76962
15YP08-060	626.63080	22.94219	640.61287	25.97654	690.23482	82.72981	0.10209	3.84887	0.87932	5.53826	0.06250	3.98228	0.02765	7.62995	0.67150	9.21484
15YP08-126	627.94881	22.73602	628.78758	22.56696	631.80545	64.03799	0.10231	3.80660	0.85756	4.86808	0.06082	3.03447	0.02696	6.30198	0.77316	0.61042
15YP08-105	628.36707	22.03211	611.46222	21.96469	549.32879	66.85507	0.10238	3.68621	0.82613	4.83375	0.05855	3.12683	0.02806	5.81199	0.75294	-14.38815
15YP08-059	629.48190	22.84507	641.09920	30.25262	682.25053	107.57077	0.10258	3.81602	0.88022	6.46007	0.06226	5.21254	0.02680	7.24134	0.54033	7.73449
15YP08-045	635.27075	27.19067	659.17955	27.49812	741.86127	73.79279	0.10357	4.50402	0.91400	5.74862	0.06404	3.57218	0.02978	7.66807	0.77701	14.36799
15YP08-005	636.53560	19.95246	637.85719	23.50951	642.54176	79.40270	0.10378	3.29694	0.87422	5.02170	0.06112	3.78782	0.02808	5.32462	0.62981	0.93475
15YP08-120	638.66198	22.42860	638.13385	26.97420	636.26421	92.60098	0.10415	3.69507	0.87473	5.76984	0.06094	4.43143	0.02809	6.40936	0.61878	-0.37685
15YP08-098	639.22558	31.35593	636.07233	44.09496	624.88461	163.98670	0.10424	5.16507	0.87093	9.53449	0.06062	8.01427	0.02570	12.12908	0.47248	-2.29498
15YP08-095	642.17842	27.27902	659.54516	28.83704	719.38926	83.60036	0.10475	4.47244	0.91468	6.03015	0.06336	4.04475	0.02995	22.01966	0.73143	10.73283
15YP08-001	644.27378	13.64517	657.93614	14.59928	705.05925	43.30720	0.10511	2.22787	0.91165	3.03674	0.06293	2.06358	0.03533	5.68274	0.69497	8.62133
15YP08-058	657.21728	23.99361	653.98003	28.21475	642.82667	94.25018	0.10733	3.84721	0.90422	5.93386	0.06113	4.51771	0.02748	6.22878	0.59938	-2.23864
15YP08-027	698.18189	24.89866	727.83402	33.09460	820.27645	106.24313	0.11439	3.77009	1.04788	6.47465	0.06647	5.26378	0.03262	6.93311	0.54318	14.88456
15YP08-026	698.38769	23.58791	728.40344	33.60277	821.91511	111.16491	0.11442	3.57026	1.04903	6.57220	0.06652	5.51788	0.03142	8.31632	0.48836	15.02922
15YP08-008	704.19799	22.38330	722.95255	31.31401	781.57809	104.63973	0.11543	3.36115	1.03806	6.14917	0.06525	5.14927	0.02920	8.23165	0.48982	9.90050
15YP08-028	717.20476	26.09124	734.00319	34.89102	785.62707	113.31001	0.11768	3.85182	1.06036	6.79291	0.06538	5.59527	0.03353	7.04272	0.51842	8.70926
15YP08-144	735.45746	31.43759	793.11185	38.70240	958.79620	109.47820	0.12085	4.53408	1.18386	7.16695	0.07108	5.55044	0.04400	8.32897	0.60311	23.29366
15YP08-038	739.26592	36.45557	744.31937	37.53356	759.54789	102.32154	0.12151	5.23427	1.08140	7.24786	0.06457	5.01337	0.03889	6.36089	0.71488	2.67027

Table 1 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP09 & 15YP08: SGT FW Terrigenous Clastics

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP08																
15YP08-069	781.99205	28.73264	810.86543	32.01951	890.97322	86.69773	0.12897	3.91036	1.22238	5.82454	0.06877	4.31676	0.03171	8.36991	0.63821	12.23170
15YP08-044	807.33573	35.08878	819.59945	39.46915	853.02930	109.32956	0.13342	4.63669	1.24158	7.15608	0.06752	5.45074	0.03708	11.32903	0.61228	5.35662
15YP08-014	809.21764	27.85421	829.45309	40.02884	884.06723	123.15216	0.13375	3.67060	1.26344	7.20354	0.06854	6.19819	0.03675	9.49526	0.42624	8.46650
15YP08-031	816.51790	28.62368	804.60557	30.72386	771.77323	85.71951	0.13503	3.74058	1.20873	5.61367	0.06495	4.18586	0.03619	6.07641	0.64467	-5.79765
15YP08-128	820.76457	31.08509	830.68657	30.56231	857.32372	74.64781	0.13578	4.04329	1.26619	5.46897	0.06766	3.68258	0.03463	6.14807	0.72339	4.26433
15YP08-102	851.53754	30.59516	880.44251	30.28417	953.81946	70.62470	0.14122	3.84457	1.38001	5.22126	0.07091	3.53282	0.04186	5.73079	0.72272	10.72340
15YP08-141	877.48672	30.70510	867.78928	38.35490	843.11153	111.44535	0.14582	3.75169	1.35053	6.70009	0.06720	5.55121	0.03628	9.64845	0.51739	-4.07718
15YP08-078	881.33826	38.76246	1116.12918	39.91007	1607.24947	67.84325	0.14650	4.71981	2.00182	6.01139	0.09914	3.72293	0.05114	8.88137	0.78180	45.16481
15YP08-013	900.10403	27.49628	907.24421	28.37206	924.66553	70.28751	0.14985	3.28001	1.44367	4.79643	0.06991	3.49961	0.04214	7.78988	0.65314	2.65626
15YP08-086	900.92701	29.35859	925.68428	26.14890	985.13490	52.09037	0.14999	3.49969	1.48845	4.36136	0.07200	2.60263	0.02792	10.49947	0.79441	8.54785
15YP08-040	904.36657	33.09102	913.00602	30.51547	933.95258	66.60386	0.15061	3.93177	1.45757	5.14409	0.07022	3.31705	0.04367	5.20601	0.75686	3.16783
15YP08-127	943.55882	34.60341	1016.64963	48.57531	1177.60464	126.39747	0.15762	3.95287	1.72167	7.74641	0.07925	6.66196	0.04108	6.12084	0.47529	19.87474
15YP08-108	945.96621	45.64017	1108.51528	46.06347	1442.99995	86.24565	0.15806	5.20577	1.97940	6.98571	0.09087	4.65833	0.10154	6.76248	0.73675	34.44447
15YP08-039	959.18540	48.85525	952.46579	48.00046	936.97314	113.52421	0.16043	5.50256	1.55496	7.95401	0.07033	5.74353	0.05052	6.17871	0.67440	-2.37064
15YP08-079	962.83472	27.43627	954.95148	26.34738	936.83321	60.81706	0.16109	3.07417	1.56122	4.31258	0.07032	3.02454	0.04408	7.26855	0.69391	-2.77547
15YP08-067	967.98345	29.67133	955.44122	31.27702	926.67170	78.51279	0.16202	3.30878	1.56246	5.13039	0.06997	3.92082	0.04005	6.05802	0.62324	-4.45808
15YP08-011	972.17288	31.38993	967.10459	39.71682	955.60319	108.17226	0.16277	3.48691	1.59206	6.49459	0.07097	5.47915	0.04246	5.24133	0.45804	-1.73395
15YP08-076	976.38870	33.27284	962.75448	36.70074	931.74479	94.51708	0.16353	3.68182	1.58098	6.00863	0.07015	4.74846	0.04182	8.69707	0.56012	-4.79143
15YP08-117	983.48007	33.39803	983.80770	32.02567	984.53882	72.22464	0.16482	3.67103	1.63505	5.16408	0.07198	3.63197	0.03864	8.41051	0.68889	0.10754
15YP08-147	986.78123	33.82328	989.37308	33.95021	995.12570	79.44737	0.16541	3.70638	1.64953	5.46137	0.07236	4.01114	0.04444	8.52451	0.65263	0.83853
15YP08-118	997.02770	21.99522	1001.07469	45.22646	1009.94775	133.25320	0.16727	2.38514	1.68025	7.26562	0.07289	6.86296	0.04897	11.14104	0.30229	1.27928
15YP08-149	998.01409	31.63246	1029.56764	29.81321	1097.22995	62.33408	0.16744	3.42963	1.75652	4.67604	0.07612	3.17852	0.04308	5.74967	0.71694	9.04239
15YP08-103	1011.15675	39.66238	1002.26229	37.85518	982.85989	85.39599	0.16983	4.25121	1.68338	6.05503	0.07192	4.31167	0.04823	8.32096	0.67539	-2.87903
15YP08-020	1015.48463	39.04603	1020.85183	34.84629	1032.37822	71.04068	0.17061	4.16847	1.73296	5.50611	0.07370	3.59736	0.04511	5.93254	0.73828	1.63638
15YP08-054	1016.23306	34.73869	1038.24253	47.18866	1084.87929	123.98573	0.17075	3.70487	1.78017	7.42930	0.07565	6.43960	0.04542	8.42379	0.40152	6.32754
15YP08-004	1016.78629	27.28478	1018.97383	26.46360	1023.67669	59.31339	0.17085	2.90677	1.72791	4.16869	0.07338	2.98809	0.04432	5.81482	0.66999	0.67310
15YP08-073	1017.50485	30.78998	1011.22239	29.87282	997.63801	67.87879	0.17098	3.27895	1.70717	4.73467	0.07245	3.41549	0.04379	5.48275	0.67936	-1.99139
15YP08-134	1021.83657	31.35808	1014.37972	26.41081	998.31540	50.29578	0.17177	3.32652	1.71560	4.17121	0.07247	2.51659	0.04102	5.42408	0.79056	-2.35609
15YP08-072	1027.99927	36.29950	1007.93041	39.80313	964.55644	100.14731	0.17289	3.83089	1.69840	6.35175	0.07128	5.06646	0.04371	7.16249	0.54555	-6.57741
15YP08-025	1031.27826	64.33482	976.32739	56.68053	854.67190	126.66335	0.17348	6.78445	1.61571	9.29411	0.06758	6.35230	0.04057	11.95917	0.69320	-20.66364
15YP08-053	1032.18699	38.29319	1047.20344	39.80601	1078.66364	92.15350	0.17365	4.02679	1.80482	6.21342	0.07541	4.73197	0.04517	6.21106	0.60520	4.30873
15YP08-099	1033.84444	37.17312	1031.74513	31.67300	1027.29763	60.89448	0.17395	3.90289	1.76244	4.96625	0.07352	3.07101	0.04611	7.00359	0.77525	-0.63728
15YP08-021	1038.72947	36.89665	1041.45488	30.22655	1047.17866	53.59004	0.17484	3.85698	1.78898	4.71062	0.07424	2.70438	0.04536	6.76840	0.81150	0.80685
15YP08-063	1039.70680	32.90294	1027.74733	27.22811	1002.37585	50.62628	0.17502	3.43546	1.75158	4.26948	0.07262	2.53498	0.04316	5.32865	0.79558	-3.72425
15YP08-106	1041.97212	49.80660	1044.49890	44.96506	1049.78853	93.07274	0.17543	5.19680	1.79736	7.04710	0.07434	4.75972	0.05040	6.97314	0.72684	0.74457
15YP08-018	1044.25722	34.69071	1046.95980	37.33839	1052.60339	89.41329	0.17585	3.60808	1.80414	5.82189	0.07444	4.56905	0.04624	8.01278	0.56062	0.79291
15YP08-115	1052.84876	39.58771	1036.36469	43.30099	1001.75091	106.83566	0.17742	4.08800	1.77504	6.81118	0.07259	5.44798	0.04625	8.86065	0.53826	-5.10085
15YP08-068	1059.05182	34.60642	1064.38149	41.86271	1075.32248	105.15911	0.17855	3.55297	1.85267	6.48088	0.07529	5.42017	0.04192	10.19276	0.48507	1.51310
15YP08-137	1087.20306	58.09473	1074.57456	62.53728	1049.04218	149.47704	0.18371	5.83300	1.88145	9.72904	0.07431	7.78654	0.04045	12.09730	0.56699	-3.63769
15YP08-132	1320.73366	35.61819	1372.19932	28.44540	1453.23737	44.94996	0.22738	2.99079	2.86287	3.83343	0.09136	2.39799	0.06645	6.29925	0.76087	9.11783
15YP08-096	1375.24033	46.39606	1409.04849	33.02339	1460.55351	43.02968	0.23780	3.75983	3.00563	4.40563	0.09171	2.29637	0.06223	5.47522	0.84811	5.84115
15YP08-136	1542.11765	47.85545	1642.62876	33.02082	1773.76212	39.20377	0.27026	3.50218	4.04170	4.12337	0.10851	2.17644	0.08949	7.92442	0.84436	13.05950
15YP08-130	1742.88289	57.83547	1752.31548	37.80169	1763.58476	46.98703	0.31044	3.80419	4.61683	4.61464	0.10791	2.61209	0.07537	6.68746	0.81763	1.17385
15YP08-123	1788.61257	49.30204	1821.38828	32.25602	1859.07980	39.65185	0.31977	3.16860	5.01222	3.87170	0.11373	2.22487	0.08181	7.98636	0.81316	3.79044
15YP08-139	1794.33199	57.23471	1892.93105	38.93414	2002.85657	49.16676	0.32094	3.67052	5.45112	4.62597	0.12324	2.81548	0.08776	6.04140	0.78507	10.41136
15YP08-066	1901.92473	55.98067	1972.74703	37.99529	2047.84956	49.60107	0.34317	3.41369	5.97868	4.45060	0.12641	2.85562	0.08407	6.12031	0.74915	7.12576
15YP08-080	1947.86556	57.42139	2057.56002	34.59179	2169.32351	35.12514	0.35278	3.43094	6.58663	3.99160	0.13547	2.03999	0.08185	5.96749	0.85646	10.20862
15YP08-029	1969.71912	55.37053	1975.27682	35.80103	1981.10145	45.70203	0.35737	3.27644	5.99609	4.18728	0.12174	2.60734	0.08708	5.77801	0.76502	0.57455
15YP08-150	1994.37419	53.92537	2004.76351	31.44577	2015.48600	32.22170	0.36258	3.15685	6.20223	3.65253	0.12412	1.83719	0.08632	5.51486	0.85962	1.04748
15YP08-046	2024.17992	69.14321	1989.19326	42.20532	1953.02942	50.87606	0.36889	4.00160	6.09264	4.94080	0.11984	2.89805	0.08775	5.67879	0.80190	-3.64308
15YP08-032	2059.47997	61.17356	2031.66482	36.77672	2003.53216	42.98579	0.37641	3.48656	6.39560	4.26505	0.12329	2.45653	0.09378	8.10091	0.80779	-2.79246
15YP08-119	2394.21390	81.05184	2485.13338	44.68161	2560.31998	45.46396	0.44977	4.07839	10.55922	4.92477	0.17035	2.76046	0.11759	5.42066	0.82468	6.48771
15YP08-047	2400.70746	74.34884	2503.32410	40.84431	2587.64522	40.97334	0.45123	3.73081	10.76817	4.48573	0.17316	2.49055	0.11702	6.48392	0.82635	7.22424
15YP08-016	2568.93830	73.42761	2598.57479	37.27028	2621.75854	33.97915	0.48960	3.48535	11.92556	4.05227	0.17674	2.06718	0.11610	5.09818	0.85528	2.01469
15YP08-111	2598.79698	110.95110	2746.22796	58.16107	2856.48322	56.49321	0.49651	5.23245	13.94867	6.31786	0.20384	3.54073	0.12133	8.98068	0.82206	9.02110
15YP08-034	2601.54327	99.13761	2667.73948	50.07036	2718.31210	45.60840	0.49715	4.66703	12.83668	5.44856	0.18735	2.81170	0.13113	7.37911	0.85012	4.29564

a Isotopic dates calculated using _238 = 1.55125E-10 (Jaffey et al. 1971) and _235 = 9.8485E-10 (Jaffey et al. 1971).

b % discordance = 100 - (100 * (206Pb/238U date) / (207Pb/206Pb date))

c Measured ratios corrected for fractionation, tracer, blank and initial common Pb.

Table 2: LA-ICP-MS Zircon Isotopic and Age Data Table: 15G002: Murdunu-Goynuk clastic

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (p)	% disc b
15G002																
15G002-052	66.69282	4.80018	79.64978	7.85943	488.04987	154.01393	0.01040	7.23743	0.08160	10.29937	0.05694	7.32780	0.00028	792.58821	0.69083	86.33483
15G002-055	73.87262	2.79437	78.48893	7.52222	221.39407	200.84403	0.01153	3.80522	0.08037	9.99596	0.05060	9.24335	0.00123	790.47590	0.26603	66.63297
15G002-051	74.09446	2.28263	76.76924	5.36327	160.85458	147.05446	0.01156	3.09899	0.07854	7.27284	0.04930	6.57955	0.00134	790.26122	0.34570	53.93699
15G002-050	74.20378	3.03419	68.92313	8.49412	-110.72571	274.40615	0.01158	4.11355	0.07024	12.80051	0.04402	12.12155	0.00141	791.78689	0.19054	167.01585
15G002-089	75.01028	3.05044	75.63006	6.56818	95.26211	180.54621	0.01170	4.09137	0.07733	9.04127	0.04794	8.06258	0.00155	800.80971	0.39204	21.25906
15G002-0138	75.02921	4.06156	74.53170	7.69091	58.60335	207.09093	0.01171	5.44658	0.07616	10.74297	0.04721	9.25992	0.00198	856.87750	0.46622	-28.02887
15G002-0127	75.33728	3.02352	88.58664	6.51706	462.07230	139.25777	0.01176	4.03775	0.09116	7.70700	0.05627	6.56463	0.00189	840.50142	0.48450	83.69578
15G002-0104	75.54367	3.60119	81.53306	9.50046	260.74263	238.68817	0.01179	4.79636	0.08361	12.18327	0.05147	11.19942	0.00160	813.79515	0.28605	71.02750
15G002-078	76.38603	2.79296	80.48823	7.06044	204.01236	183.76163	0.01192	3.67887	0.08250	9.15608	0.05022	8.38450	0.00150	795.86492	0.31802	62.55814
15G002-0128	76.70464	2.93100	81.65950	5.72825	229.12018	137.89167	0.01197	3.84480	0.08374	7.32128	0.05076	6.23046	0.00188	841.20816	0.46117	66.52209
15G002-0121	76.90662	3.61847	79.63241	8.03329	162.20032	206.30039	0.01200	4.73446	0.08158	10.53032	0.04932	9.40598	0.00171	833.08939	0.38663	52.58541
15G002-0130	76.97268	3.39368	74.89358	7.39857	9.02549	209.36553	0.01201	4.43649	0.07655	10.28501	0.04624	9.27896	0.00190	843.57690	0.32490	-752.83617
15G002-073	77.15804	3.21325	81.80852	9.62392	219.80032	247.69240	0.01204	4.19052	0.08390	12.30243	0.05056	11.56673	0.00157	794.62935	0.20826	64.89630
15G002-090	77.24168	3.30505	90.13808	9.40980	446.59076	209.62478	0.01205	4.30563	0.09283	10.96024	0.05588	10.07911	0.00151	803.15373	0.29266	82.70415
15G002-075	77.27378	2.82574	77.00033	7.75157	68.52106	218.57081	0.01206	3.67955	0.07878	10.49346	0.04740	9.82719	0.00158	795.34751	0.22938	-12.77378
15G002-0110	77.62698	2.89641	80.30037	6.20276	160.58031	158.79075	0.01211	3.75454	0.08230	8.05850	0.04929	7.13042	0.00175	820.40783	0.40384	51.65847
15G002-092	77.88119	3.73564	81.09240	10.90669	176.74499	282.18189	0.01215	4.82702	0.08314	14.06935	0.04963	13.21539	0.00195	807.92605	0.20078	55.93584
15G002-093	78.30983	2.89332	82.43834	7.66517	203.75696	196.01567	0.01222	3.71803	0.08458	9.71725	0.05021	8.97782	0.00169	804.40628	0.28940	61.56704
15G002-083	78.38081	2.54787	77.13931	6.45888	38.84319	182.90764	0.01223	3.27108	0.07893	8.72280	0.04682	8.08624	0.00163	798.50762	0.25279	-101.78778
15G002-065	78.55952	2.81014	81.60557	6.24336	171.70424	158.45712	0.01226	3.59971	0.08369	7.98674	0.04952	7.12953	0.00167	792.09520	0.38656	54.24719
15G002-094	78.58000	3.41779	82.85589	7.27345	207.92216	176.96015	0.01226	4.37717	0.08502	9.17429	0.05030	8.06275	0.00162	804.78350	0.40782	62.20701
15G002-0115	78.61624	3.74204	85.24163	7.50365	275.02459	170.88239	0.01227	4.79036	0.08757	9.21146	0.05179	7.86788	0.00199	826.08245	0.46154	71.41483
15G002-077	78.83450	3.07464	80.38226	8.37679	126.62857	222.98284	0.01230	3.92495	0.08238	10.88396	0.04858	10.15162	0.00152	795.42889	0.26540	37.74351
15G002-0136	78.96110	3.62743	83.28279	7.04095	209.04539	165.81836	0.01232	4.62344	0.08548	8.83633	0.05033	7.53024	0.00173	854.55582	0.47768	62.22777
15G002-091	79.00830	2.80772	80.38764	5.72940	121.57451	146.75570	0.01233	3.57631	0.08239	7.43403	0.04848	6.51727	0.00154	803.50394	0.39799	35.01244
15G002-020	79.13439	4.87332	83.05052	11.33097	197.17503	274.50682	0.01235	6.19851	0.08523	14.28862	0.05007	12.87413	0.00202	802.72963	0.35524	59.86592
15G002-0144	79.24277	6.38752	88.20150	15.91945	337.95571	348.26864	0.01237	8.11436	0.09075	18.99272	0.05324	17.17209	0.00204	867.14162	0.31259	76.55232
15G002-023	79.38755	3.74933	82.54053	6.62946	174.75935	153.79445	0.01239	4.75334	0.08469	8.38999	0.04959	6.91359	0.00174	797.94212	0.53295	54.57322
15G002-054	79.57311	4.56337	82.96835	12.81926	181.83347	318.95169	0.01242	5.77232	0.08514	16.19264	0.04974	15.12884	0.00157	792.65545	0.23085	56.23847
15G002-053	79.79142	2.28858	83.35452	6.06353	186.67707	155.93653	0.01245	2.88651	0.08556	7.59972	0.04984	7.03021	0.00139	790.11430	0.27504	57.25698
15G002-085	79.86470	3.26442	81.15230	9.00636	119.22056	237.45802	0.01247	4.11385	0.08320	11.59886	0.04843	10.84481	0.00157	800.67576	0.24552	33.01097
15G002-076	79.95993	4.62611	75.80803	11.33277	-53.22075	319.37108	0.01248	5.82358	0.07752	15.60120	0.04507	14.47354	0.00148	797.75831	0.27519	250.24201
15G002-0131	79.96480	3.72800	84.96636	7.23715	227.89604	166.20442	0.01248	4.69239	0.08728	8.91072	0.05074	7.57513	0.00204	846.63400	0.48586	64.91172
15G002-0126	79.97782	3.60403	81.11090	7.30241	114.61058	183.55043	0.01248	4.53556	0.08316	9.40113	0.04833	8.23468	0.00186	840.13650	0.42750	30.21777
15G002-0143	80.55022	4.42757	86.03268	10.85354	240.96793	255.63707	0.01257	5.53298	0.08842	13.22818	0.05103	12.01544	0.00212	864.96635	0.33658	66.57222
15G002-074	80.94760	3.48835	85.88895	9.78788	225.51243	238.69517	0.01264	4.33768	0.08827	11.94221	0.05069	11.12658	0.00158	795.41334	0.24053	64.10504
15G002-019	81.06584	3.64804	84.26983	8.11059	176.03543	197.29495	0.01265	4.52973	0.08653	10.06962	0.04962	8.99327	0.00174	800.43296	0.37639	53.94913
15G002-082	81.29305	2.65367	95.72259	8.14504	472.02022	174.37840	0.01269	3.28563	0.09886	8.95224	0.05652	8.32750	0.00165	798.50909	0.22924	82.77763
15G002-003	81.32860	3.54926	83.99445	8.24497	160.46231	203.81456	0.01270	4.39289	0.08624	10.26933	0.04929	9.28233	0.00161	816.48061	0.34138	49.31607
15G002-013	81.42205	3.10480	84.10188	7.73230	160.87452	194.17820	0.01271	3.83828	0.08635	9.61655	0.04930	8.81735	0.00161	805.01653	0.33184	49.38785
15G002-0120	81.54535	3.68876	87.99289	6.32681	266.61384	132.04883	0.01273	4.55354	0.09053	7.52962	0.05160	5.99670	0.00192	829.86202	0.57453	69.41443
15G002-0103	81.55804	4.25945	90.27967	10.70003	327.40789	237.71461	0.01273	5.25744	0.09298	12.45229	0.05299	11.28800	0.00180	812.77150	0.34443	75.08978
15G002-024	82.98093	3.49891	85.91166	7.81149	168.14004	187.75834	0.01296	4.24487	0.08829	9.51912	0.04945	8.52026	0.00188	797.77903	0.39596	50.64772
15G002-0113	83.03817	4.67289	84.32885	12.18532	121.03242	301.34814	0.01296	5.65577	0.08660	15.14882	0.04847	14.04941	0.00217	826.90369	0.27733	31.39179
15G002-068	84.94239	3.30457	94.32652	7.25231	338.63430	152.60117	0.01326	3.91706	0.09735	8.07999	0.05325	7.06702	0.00211	795.94966	0.41143	74.91619
15G002-072	85.39083	3.24451	88.22493	5.21814	165.59362	109.96044	0.01333	3.82578	0.09077	6.19115	0.04940	4.86762	0.00177	793.08036	0.58500	48.43350
15G002-0145	87.19488	4.35848	88.98542	10.57114	137.27984	248.16717	0.01362	5.03413	0.09159	12.47260	0.04880	11.41154	0.00250	868.62825	0.33306	36.48384
15G002-086	87.49938	3.54281	87.36745	7.79382	83.76408	188.27032	0.01367	4.07761	0.08985	9.34584	0.04771	8.40939	0.00205	800.00756	0.35570	-4.45931
15G002-033	87.58227	4.84884	93.53034	10.96862	248.01876	235.46627	0.01368	5.57612	0.09649	12.34230	0.05118	11.01087	0.00198	793.78023	0.37880	64.68724
15G002-037	92.58470	5.00967	96.86446	8.68474	203.54779	169.68355	0.01447	5.45197	0.10010	9.44064	0.05021	7.70725	0.00200	792.56348	0.55375	54.51451
15G002-004	92.64575	5.17317	92.92338	7.31253	100.05718	137.28247	0.01448	5.62630	0.09583	8.26472	0.04804	6.05396	0.00190	814.89290	0.67151	7.40720
15G002-069	94.23922	4.75775	95.32003	7.48337	122.44902	146.39370	0.01473	5.08746	0.09842	8.25543	0.04850	6.50153	0.00201	792.44498	0.59258	23.03799
15G002-007	107.20667	9.74349	120.50532	19.47434	391.68763	299.39877	0.01677	9.17122	0.12601	17.30390	0.05452	14.67357	0.00251	812.88337	0.50891	72.62955
15G002-036	107.50885	10.90207	255.26588	52.27488	2004.02677	338.55884	0.01682	10.23407	0.28582	23.76704	0.12332	21.45078	0.25577	793.32368	0.35327	94.63536
15G002-0106	213.19478	10.50836	229.99361	27.11592	405.40370	255.48655	0.03362	5.01504	0.25421	13.35298	0.05486	12.37544	0.00536	818.26177	0.28676	47.41173
15G002-081	230.02035	7.21943	230.27849	12.90371	232.91475	120.78338	0.03633	3.19672	0.25457	6.30290	0.05085	5.43208	0.00432	796.87830	0.42460	1.24269
15G002-0105	236.05995	10.86533	235.14587	24.99570	226.02137	238.25710	0.03730	4.69153	0.26059	12.05597	0.05070	11.10567	0.00547	816.50608	0.28513	-4.44143
15G002-018	257.35870	11.66630	258.19982	17.51172	265.84324	136.63999	0.04073	4.62837	0.28954	7.74768	0.05158	6.21328	0.00571	800.76104	0.56770	3.19156
15G002-084	263.56933	8.36164	264.05085	19.75998	268.32520	172.70763	0.04173	3.23986	0.29700	8.58179	0.05164	7.94672	0.00505	800.00028	0.25432	1.77243
15G002-0102	271.74340	9.49672	277.43278	17.24265	325.68866	135.14300	0.04306	3.57154	0.31420	7.16341	0.05295	6.20955	0.00658	812.46302	0.42107	16.56344
15G002-0118	283.67044	9.93184	302.50171	15.44189	450.42252	102.13938	0.04499	3.58155	0.34705	5.94794	0.05598	4.74874	0.00671	828.86553	0.56409	37.02126
15G002-021	298.47855	11.84770	305.09850	18.93131	356.02965	130.16526	0.04739	4.06570	0.35050	7.25121	0.05367	6.00418	0.00699	799.71646	0.52086	16.16470
15G002-039	299.47950	13.56573	311.68706	26.50898	404.02844	187.14300	0.04755	4.64068	0.35929	10.00711	0.05482	8.86602	0.00639	793.63342	0.42625	25.87663
15G002-022	300.49439	13.56319	312.14009	26.74244	400.05157	189.15965	0.04772	4.62451	0.35990	10.08388	0.05473	8.96095	0.00713	799.98875	0.39427	24.88609
15G002-001	301.91130	13.66006	297.01084	20.62695	258.73133	145.62437	0.04795	4.63622	0.33980	8.09175	0.05142	6.63189	0.00599	817.16915	0.54674	-16.68912
15G002-008	305.74778	12.97542	323.45089	19.90830	452.93738	124.05628	0.04857	4.34964	0.37513	7.25818	0.05604	5.81050	0.00620	810.84519	0.56050	32.49668
15G002-057	307.01326	14.09100	334.08408	33.85603	527.13029	227.13547	0.04878	4.70500	0.38961	12.09288	0.05796	11.14005	0.00508	792.50444	0.27806	41.75761
15G002-0129	308.08897	11.88030	321.16277	21.09470	417.09107	142.20402	0.04895	3.95265	0.37204	7.74179	0.05514	6.65672	0.00702	842.62628	0.45220	26.13388
15G002-098	308.74668	9.32842	317.89610	13.74653	385.50517	87.75686	0.04906	3.09655	0.36763	5.07065	0.05437	4.01532	0.00688	807.80387	0.57201	19.91114
15G002-097	308.90598	10.34864	308.97700	19.68868	309.51306	144.21804	0.04909	3.43376	0.35567	7.46295	0.05258	6.62608	0.00733	807.40906	0.40236	0.19614
15G002-0141	310.70841	14.07915	323.38503	20.66067	415.69825	127.39056	0.04938	4.64646	0.37504	7.53659	0.05511	5.93385	0.00814	859.62846	0.60296	25.25626

Table 2 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15G002: Murdunu-Goynuk clastic

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (p)	% disc b
15G002-059	311.37714	9.57091	319.81120	15.82119	381.70584	106.19370	0.04949	3.15091	0.37021	5.81211	0.05428	4.88389	0.00598	790.93791	0.47927	18.42484
15G002-025	312.43815	11.16484	325.99210	21.56178	423.94800	147.06497	0.04966	3.66393	0.37858	7.81536	0.05531	6.90330	0.00646	797.39896	0.36842	26.30272
15G002-044	313.39235	9.49534	325.72843	21.68030	414.85978	153.82820	0.04982	3.10639	0.37822	7.86418	0.05509	7.22465	0.00673	791.13131	0.26094	24.45825
15G002-009	316.64938	16.89802	300.37320	31.20880	175.74007	236.00461	0.05035	5.47582	0.34423	12.18883	0.04961	10.88958	0.00634	808.23447	0.37970	-80.18052
15G002-012	317.11606	14.63808	320.74144	30.60340	347.15274	216.66938	0.05042	4.73584	0.37147	11.29704	0.05346	10.25645	0.00707	807.49677	0.35018	8.65229
15G002-080	317.48671	8.73502	316.32020	14.04359	307.73564	96.61211	0.05048	2.82152	0.36551	5.20296	0.05253	4.37148	0.00594	796.30233	0.49845	-3.16865
15G002-0123	318.01414	10.95124	317.04107	15.97856	309.89574	104.52833	0.05057	3.53227	0.36648	5.91402	0.05258	4.74328	0.00705	834.63486	0.54683	-2.61972
15G002-088	319.60541	9.72024	324.81943	16.01595	362.36275	106.84430	0.05083	3.11969	0.37699	5.80704	0.05382	4.89788	0.00601	800.71174	0.48581	11.79960
15G002-038	319.89488	12.97916	311.89285	30.15117	252.50166	227.26621	0.05088	4.16301	0.35957	11.39613	0.05128	10.60854	0.00740	793.12807	0.25644	-26.69021
15G002-079	320.48242	9.44615	320.20588	16.84122	318.19466	118.17824	0.05097	3.02357	0.37075	6.18345	0.05278	5.39381	0.00590	795.42787	0.42340	-0.71898
15G002-0108	320.68052	14.64663	330.77341	19.93685	402.39426	116.09160	0.05100	4.68723	0.38509	7.13208	0.05478	5.37554	0.00867	823.42853	0.64038	20.30689
15G002-087	323.60126	10.08858	314.66261	16.55574	248.97141	117.07220	0.05148	3.19900	0.36328	6.16887	0.05120	5.27459	0.00654	800.17727	0.48445	-29.97527
15G002-0140	323.66014	14.00281	316.60690	20.20152	265.01459	133.12246	0.05149	4.44073	0.36590	7.50139	0.05156	6.04572	0.00797	859.08845	0.57067	-22.12918
15G002-056	323.92466	14.93105	324.34918	37.25200	327.39776	267.43391	0.05153	4.73168	0.37635	13.66619	0.05299	12.82092	0.00570	791.85855	0.24947	1.06082
15G002-045	324.45163	12.68847	324.88158	24.47351	327.96388	171.07847	0.05162	4.01393	0.37707	8.90929	0.05300	7.95385	0.00629	791.29638	0.37914	1.07093
15G002-026	325.38476	17.43360	322.04898	30.52117	297.99578	209.11828	0.05177	5.50163	0.37324	11.22733	0.05231	9.78698	0.00611	798.65922	0.40458	-9.19107
15G002-0134	327.24630	10.80700	337.78671	16.49256	410.99371	101.58897	0.05207	3.38978	0.39469	5.78648	0.05499	4.68965	0.00747	849.51083	0.55408	20.37681
15G002-0125	328.40885	12.32795	330.25953	21.09868	343.31972	140.89311	0.05226	3.85396	0.38439	7.56198	0.05336	6.50620	0.00754	836.78174	0.47928	4.34314
15G002-0133	328.78291	11.89059	332.08261	17.98189	355.26485	113.74836	0.05233	3.71298	0.38687	6.40509	0.05365	5.21909	0.00800	848.71214	0.53575	7.45414
15G002-0124	334.33914	11.42236	336.00047	16.50390	347.51531	101.62948	0.05323	3.50887	0.39223	5.81644	0.05346	4.63884	0.00829	835.06704	0.58600	3.79153
15G002-043	335.97536	11.16418	340.32681	23.93703	370.15711	163.66530	0.05350	3.41322	0.39818	8.37633	0.05400	7.64937	0.00656	792.71625	0.30678	9.23439
15G002-0147	336.71385	17.84431	337.50495	30.26929	342.95887	196.00380	0.05362	5.44669	0.39430	10.70020	0.05336	9.21020	0.00940	871.14242	0.45358	1.82092
15G002-014	342.52511	16.05037	348.52771	31.45402	388.72685	204.16164	0.05457	4.81748	0.40952	10.82900	0.05445	9.69840	0.00776	804.72981	0.38079	11.88540
15G002-0122	363.04314	16.72298	350.21725	25.04177	266.01978	155.74103	0.05793	4.74341	0.41186	8.55933	0.05158	7.12476	0.00883	834.54819	0.52124	-36.47224
15G002-058	384.45165	26.38076	377.19886	31.16055	332.90338	153.85745	0.06145	7.08305	0.44989	10.04357	0.05312	7.12065	0.00715	790.59291	0.69490	-15.48445
15G002-0137	391.29545	13.90421	392.63383	19.63969	400.52410	105.40840	0.06258	3.66627	0.47209	6.09003	0.05474	4.86281	0.00963	855.25456	0.58176	2.30414
15G002-006	393.86269	17.28368	388.47294	24.00984	356.49962	130.29811	0.06300	4.52974	0.46607	7.52672	0.05368	6.01106	0.00768	811.73091	0.58024	-10.48053
15G002-096	396.85808	13.85905	406.28132	22.52551	460.20264	123.05026	0.06350	3.60466	0.49201	6.80248	0.05622	5.76889	0.00889	806.76926	0.47124	13.76449
15G002-0112	410.28343	16.50740	415.06570	26.95934	441.73850	145.67553	0.06571	4.15813	0.50498	8.01892	0.05576	6.85661	0.00988	821.80823	0.46213	7.12074
15G002-0111	410.73588	16.24638	415.55522	25.18695	442.40244	133.53664	0.06579	4.08793	0.50570	7.47803	0.05577	6.26177	0.00907	821.47780	0.48383	7.15786
15G002-005	415.72847	17.44564	449.03012	28.27716	623.39112	136.36603	0.06661	4.33904	0.55617	7.90163	0.06058	6.60368	0.00931	813.60002	0.52125	33.31177
15G002-061	436.00715	15.16944	451.10891	22.18624	528.83365	105.85133	0.06998	3.60239	0.55936	6.15833	0.05800	4.99477	0.01098	790.68593	0.53624	17.55306
15G002-049	461.35158	11.41243	460.55014	15.74046	456.55445	74.37327	0.07419	2.56554	0.57393	4.28437	0.05613	3.43130	0.00901	791.59174	0.56213	-1.05072
15G002-060	565.05407	15.35629	575.66313	25.89240	617.76737	109.42531	0.09161	2.84190	0.76287	5.96845	0.06042	5.24843	0.01107	790.37254	0.41174	8.53287
15G002-0146	586.27834	27.28654	577.64494	29.15444	543.83087	97.73971	0.09521	4.87936	0.76631	6.71408	0.05840	4.61201	0.01339	870.51341	0.72114	-7.80527
15G002-041	589.53769	19.20746	612.40965	32.18608	697.92986	127.56716	0.09576	3.41439	0.82783	7.11104	0.06272	6.23770	0.01283	791.49114	0.40869	15.53052
15G002-042	597.74030	20.58308	606.09703	29.59936	637.46710	114.14393	0.09716	3.61136	0.81651	6.58075	0.06098	5.50131	0.01273	790.97054	0.51071	6.23198
15G002-030	609.01055	19.94412	647.56949	29.46324	784.41523	105.83943	0.09908	3.43728	0.89224	6.24399	0.06534	5.21273	0.01400	794.60683	0.50475	22.36120
15G002-070	625.84998	26.63469	596.69629	51.99642	487.37896	224.87659	0.10195	4.47493	0.79977	11.82399	0.05692	10.94449	0.01296	792.78495	0.25550	-28.41136
15G002-040	627.28312	24.33258	672.39318	33.79570	826.60574	114.12909	0.10220	4.07852	0.93907	6.98836	0.06667	5.67476	0.01560	793.60733	0.55576	24.11338
15G002-031	630.89722	25.51514	673.16534	35.30049	817.29299	119.27078	0.10282	4.25381	0.94054	7.29906	0.06638	5.93139	0.01502	796.41466	0.55241	22.80648
15G002-0117	671.48400	19.80143	671.97290	24.00502	673.61228	80.07945	0.10978	3.10993	0.93826	4.94201	0.06201	3.84081	0.01566	827.40356	0.61620	0.31595
15G002-016	684.39878	28.05100	726.65356	36.17724	859.32271	112.54784	0.11201	4.32947	1.04551	7.09643	0.06773	5.62272	0.01853	802.46773	0.58314	20.35602
15G002-0109	724.74740	23.29233	737.64887	32.29532	777.02535	106.72600	0.11899	3.40405	1.06778	6.25832	0.06511	5.25158	0.01764	817.61276	0.50610	6.72796
15G002-047	794.04588	17.85406	816.15892	25.41140	876.92880	78.98669	0.13108	2.39313	1.23400	4.58788	0.06831	3.91428	0.01579	790.47050	0.48095	9.45150
15G002-046	840.76524	29.12896	874.25904	30.22446	960.07285	73.78289	0.13931	3.70378	1.36556	5.23398	0.07112	3.69818	0.01592	790.59226	0.69627	12.42693
15G002-0142	935.14496	37.56499	938.46508	47.15259	946.26688	129.31182	0.15611	4.32803	1.51997	7.88059	0.07065	6.58574	0.02482	864.18628	0.50705	1.17535
15G002-0116	951.88326	37.22436	1013.58696	39.43296	1149.42750	89.48717	0.15912	4.21859	1.71348	6.27101	0.07814	4.63994	0.03427	826.81424	0.64955	17.18632
15G002-015	980.84110	33.58455	1007.11581	37.31328	1064.73200	90.95787	0.16434	3.70078	1.69624	5.94989	0.07489	4.65891	0.02132	802.70308	0.59141	7.87906
15G002-0135	996.84391	33.68428	1027.94409	39.91934	1094.73966	99.38949	0.16723	3.65663	1.75212	6.29828	0.07602	5.12810	0.02548	850.35228	0.55350	8.94238
15G002-0132	997.96824	37.02456	1026.83460	49.51152	1088.86392	129.62973	0.16744	4.01609	1.74911	7.85385	0.07580	6.74937	0.02684	847.63140	0.45650	8.34775
15G002-0139	1077.55017	115.55409	3024.28523	143.69686	4817.67610	147.36411	0.18194	11.75000	18.65766	16.01714	0.74409	10.88514	0.28440	880.75746	0.59565	77.63340
15G002-099	1792.88354	43.20395	1838.52398	35.49798	1890.58928	56.97770	0.32065	2.76963	5.11454	4.25348	0.11574	3.22819	0.04116	808.01604	0.63753	5.16800
15G002-017	1872.09469	59.04686	1923.74944	45.93290	1979.88029	70.26494	0.33697	3.65087	5.64992	5.44663	0.12166	4.04191	0.04294	801.79263	0.65197	5.44405
15G002-062	1890.01330	42.51446	1963.38172	34.96317	2041.62379	54.85226	0.34070	2.60385	5.91461	4.09563	0.12597	3.16136	0.03818	790.56774	0.61156	7.42598
15G002-063	1944.78350	41.98277	1988.64435	31.88820	2034.55065	47.67837	0.35213	2.50888	6.08880	3.71431	0.12546	2.73892	0.03958	790.97426	0.66482	4.41214
15G002-0101	1999.55348	56.19088	2031.06655	40.27215	2063.23681	57.64953	0.36367	3.28278	6.39124	4.67895	0.12752	3.33405	0.05249	810.80751	0.68607	3.08657
15G002-048	2267.85726	48.19649	2468.18576	33.64843	2637.54289	44.02363	0.42163	2.53034	10.36789	3.69437	0.17842	2.69179	0.04623	789.81302	0.67485	14.01629
15G002-035	2377.37635	61.70070	2448.90027	41.80333	2508.84175	56.15251	0.44598	3.11814	10.15401	4.61684	0.16520	3.40477	0.05011	792.55809	0.66518	5.24008

a Isotopic dates calculated using λ238 = 1.55125E-10 (Jaffey et al. 1971) and λ235 = 9.8485E-10 (Jaffey et al. 1971).

b % discordance = 100 - (100 * (206Pb/238U date) / (207Pb/206Pb date))

c Measured ratios corrected for fractionation, tracer, blank and initial common Pb.

Table 3: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP04: SGTHW Trans-Marine

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP04																
15YP04-030	312.12882	11.35522	304.21468	19.17850	243.95184	140.07285	0.04961	3.73006	0.34933	7.36509	0.05109	6.35068	0.00991	270.43543	0.45822	-27.94690
15YP04-019	316.08609	11.52337	312.79275	19.50099	288.32097	137.62974	0.05025	3.73909	0.36077	7.31399	0.05209	6.28599	0.00842	269.77785	0.48148	-9.62993
15YP04-038	316.47949	11.76864	321.47004	21.21458	357.78545	146.21218	0.05032	3.81412	0.37245	7.77992	0.05371	6.78083	0.00942	270.78997	0.44354	11.54490
15YP04-028	316.77639	12.43104	302.73144	19.76732	195.82886	143.94549	0.05037	4.02532	0.34736	7.62533	0.05004	6.47630	0.00881	270.47441	0.48593	-61.76185
15YP04-004	318.41891	11.11992	315.12336	20.29460	290.82160	145.49666	0.05063	3.58228	0.36390	7.56654	0.05215	6.66482	0.00814	269.52088	0.41811	-9.48943
15YP04-011	319.54714	11.30981	325.13601	20.01867	365.35092	135.98159	0.05082	3.63095	0.37742	7.26670	0.05389	6.29453	0.00897	269.61226	0.46025	12.53693
15YP04-035	319.98847	11.86122	321.48726	20.53617	332.35952	140.97034	0.05089	3.80302	0.37248	7.52826	0.05311	6.49706	0.00957	270.59499	0.45994	3.72219
15YP04-027	320.17517	11.57871	337.34911	18.88555	457.48571	117.74182	0.05092	3.71025	0.39408	6.64116	0.05615	5.50809	0.00932	270.13121	0.53265	30.01417
15YP04-026	320.22355	10.74115	321.36664	18.11030	329.65931	123.77056	0.05093	3.44113	0.37231	6.63314	0.05304	5.67073	0.00899	270.04597	0.47292	2.86228
15YP04-073	320.53003	10.66742	338.49288	21.57325	463.79035	143.21235	0.05098	3.41431	0.39566	7.57474	0.05631	6.76160	0.01003	273.34082	0.39484	30.88903
15YP04-059	320.60985	13.85715	305.35719	23.39787	190.39938	172.08017	0.05099	4.43526	0.35085	8.97530	0.04992	7.80286	0.00996	272.71037	0.45017	-68.38807
15YP04-016	320.61762	12.00372	316.52321	20.86334	286.48888	147.02249	0.05099	3.84139	0.36578	7.75142	0.05205	6.73263	0.00822	270.19392	0.44560	-11.91276
15YP04-055	320.90446	13.20709	329.44493	23.52473	390.22091	156.61254	0.05104	4.22320	0.38327	8.45928	0.05449	7.32967	0.01137	272.18993	0.45327	17.76339
15YP04-119	321.01773	11.67266	313.11285	19.29574	254.67211	136.48038	0.05106	3.73081	0.36120	7.22996	0.05133	6.19301	0.00988	277.89106	0.48916	-26.05139
15YP04-017	321.26329	10.40540	322.94511	19.39179	335.09005	135.74256	0.05110	3.32296	0.37445	7.07747	0.05317	6.24888	0.00896	269.89435	0.41695	4.12628
15YP04-033	321.55714	10.94313	324.22219	21.00523	343.40545	147.03289	0.05115	3.49171	0.37618	7.64678	0.05337	6.80302	0.00962	270.45006	0.39549	6.36225
15YP04-020	321.59475	10.86428	310.69475	17.74202	229.67897	126.97815	0.05115	3.46614	0.35797	6.68683	0.05078	5.71835	0.00882	269.80136	0.48925	-40.01924
15YP04-081	322.03083	11.37912	333.95884	25.31946	417.89556	174.34918	0.05122	3.62574	0.38944	9.00848	0.05516	8.24661	0.00970	273.99620	0.32180	22.93988
15YP04-012	322.03663	10.75907	309.47240	18.79848	215.84444	138.25044	0.05122	3.42795	0.35633	7.11264	0.05047	6.23207	0.00854	269.56662	0.44115	-49.19848
15YP04-015	322.07427	11.21928	314.53476	17.55636	259.03601	121.36519	0.05123	3.57430	0.36311	6.54721	0.05143	5.48547	0.00888	269.88039	0.51450	-24.33571
15YP04-071	322.39025	13.20141	328.38049	22.27327	371.05656	147.05881	0.05128	4.20240	0.38183	8.02628	0.05402	6.83820	0.01034	273.22958	0.49343	13.11560
15YP04-041	322.56344	12.72056	323.25907	20.78007	328.27305	139.31865	0.05131	4.04706	0.37487	7.58310	0.05301	6.41285	0.00938	270.67841	0.50607	1.73929
15YP04-092	322.65537	11.28208	317.20982	18.66352	277.39989	129.96636	0.05133	3.58801	0.36671	6.91381	0.05184	5.90990	0.00969	274.82272	0.49452	-16.31416
15YP04-047	322.96337	11.73771	324.56150	21.47591	336.04186	148.50845	0.05138	3.72957	0.37664	7.81300	0.05319	6.86537	0.00967	271.44878	0.42938	3.89192
15YP04-067	324.01840	12.77539	328.11565	19.45320	357.28192	124.16754	0.05155	4.04672	0.38147	7.00508	0.05370	5.71797	0.01061	272.56545	0.54745	9.31016
15YP04-009	324.16271	11.50309	327.22648	18.38849	349.07778	120.70664	0.05157	3.64177	0.38026	6.63343	0.05350	5.54436	0.00855	269.37601	0.51865	7.13740
15YP04-079	324.19257	12.53513	324.60098	20.68682	327.53142	138.86574	0.05158	3.96847	0.37669	7.52222	0.05299	6.39023	0.00968	273.87660	0.49350	1.01940
15YP04-018	324.51072	13.84942	333.41416	21.20810	396.00817	132.03428	0.05163	4.38081	0.38869	7.54075	0.05463	6.13771	0.00863	270.03326	0.54386	18.05454
15YP04-061	325.26178	11.83891	323.90806	18.52115	314.18802	122.81615	0.05175	3.73584	0.37575	6.73974	0.05268	5.60960	0.00964	271.99417	0.53453	-3.52457
15YP04-034	325.52415	10.94434	324.60672	18.23379	318.03151	123.62797	0.05179	3.45060	0.37670	6.62211	0.05277	5.65206	0.00894	270.37065	0.48704	-2.35594
15YP04-111	325.58910	14.44496	319.65237	22.50815	276.61059	151.56579	0.05180	4.55464	0.37000	8.29951	0.05182	6.93809	0.01058	277.68604	0.50551	-17.70666
15YP04-039	326.23029	11.31167	325.15167	18.48323	317.43567	124.25608	0.05191	3.55899	0.37744	6.70398	0.05276	5.68128	0.00918	270.59936	0.50466	-2.77052
15YP04-096	326.31644	12.92908	330.01838	19.88468	356.20417	126.99852	0.05192	4.06733	0.38406	7.12700	0.05367	5.85243	0.00954	275.19658	0.54029	8.39062
15YP04-005	326.41029	12.28594	324.31319	19.81479	309.28451	132.90506	0.05194	3.86373	0.37630	7.20745	0.05257	6.08432	0.00827	269.13701	0.51185	-5.53722
15YP04-042	326.71007	12.98102	335.78328	19.18684	399.11159	116.85643	0.05199	4.07889	0.39194	6.77465	0.05470	5.40911	0.00932	270.69519	0.58605	18.14067
15YP04-006	327.69705	10.83053	323.15221	17.90097	290.52982	122.56406	0.05215	3.39261	0.37473	6.52500	0.05214	5.57367	0.00964	269.41680	0.48934	-12.79291
15YP04-077	327.75036	11.54213	346.75229	20.02903	476.10212	124.60381	0.05216	3.61514	0.40706	6.88618	0.05663	5.86091	0.01029	273.44822	0.48064	31.15965
15YP04-032	327.86412	10.73245	336.73983	19.61478	398.49588	129.93286	0.05218	3.36019	0.39325	6.91061	0.05469	6.03868	0.00929	270.28748	0.45127	17.72459
15YP04-107	327.88140	11.19937	346.95588	18.59493	476.72765	113.83414	0.05218	3.50632	0.40734	6.38545	0.05664	5.33663	0.01040	276.57217	0.52568	31.22249
15YP04-037	328.02543	10.75483	331.49237	18.39798	355.89798	122.48507	0.05220	3.36559	0.38607	6.56451	0.05366	5.63610	0.00968	270.66790	0.47852	7.83161
15YP04-087	328.22423	11.19680	326.58435	19.26768	314.91196	131.44443	0.05223	3.50195	0.37938	6.96519	0.05270	6.02082	0.00958	274.18547	0.47926	-4.22730
15YP04-070	328.25753	10.54411	323.62819	17.92575	290.45198	123.79341	0.05224	3.29732	0.37537	6.52595	0.05214	5.63167	0.00932	272.64445	0.47471	-13.01611
15YP04-109	328.46465	10.77302	319.71598	19.44301	256.45193	139.03058	0.05227	3.36689	0.37008	7.15723	0.05137	6.31585	0.00959	276.68710	0.43320	-28.08040
15YP04-126	328.81477	11.85011	346.74694	22.57091	468.70361	144.52748	0.05233	3.69998	0.40705	7.76995	0.05644	6.83245	0.00926	279.17466	0.43365	29.84591
15YP04-115	328.83208	12.05337	312.09094	17.29006	188.84216	118.61368	0.05233	3.76331	0.35983	6.49012	0.04989	5.28765	0.00941	277.45776	0.56120	-74.13065
15YP04-100	328.87329	12.74970	333.18398	24.78335	363.39130	168.64465	0.05234	3.98045	0.38838	8.83271	0.05384	7.88497	0.00992	276.19253	0.40129	9.49885
15YP04-128	329.09756	11.03660	328.89688	19.04535	327.47713	128.91879	0.05238	3.44287	0.38253	6.84303	0.05299	5.91386	0.01064	279.29005	0.46967	-0.49482
15YP04-094	329.21751	11.08680	329.79550	18.50268	333.87587	123.41893	0.05240	3.45732	0.38375	6.63093	0.05314	5.65829	0.01010	275.01755	0.49400	1.39524
15YP04-008	329.34177	10.99804	322.35681	17.06002	272.19639	115.01386	0.05242	3.42835	0.37365	6.22891	0.05172	5.20055	0.00864	269.37395	0.52250	-20.99417
15YP04-127	329.59894	11.73476	331.98146	19.12667	348.71217	125.14294	0.05246	3.65543	0.38673	6.81846	0.05349	5.75580	0.00981	279.29756	0.50814	5.48109
15YP04-068	329.67305	13.48487	337.52905	19.47605	392.00928	116.98116	0.05247	4.20025	0.39433	6.84774	0.05453	5.40827	0.00981	272.42079	0.59416	15.90172
15YP04-045	329.79348	11.83310	319.38644	19.20704	244.15613	133.51354	0.05249	3.68398	0.36964	7.07575	0.05110	6.04107	0.00979	271.02598	0.48735	-35.07483
15YP04-021	329.84012	12.28242	327.17069	19.33205	308.22189	127.74217	0.05250	3.82347	0.38018	6.97807	0.05255	5.83734	0.00942	269.83205	0.51928	-7.01385
15YP04-085	329.95334	13.82198	352.90655	20.72086	506.81233	117.63197	0.05252	4.30180	0.41561	7.02223	0.05742	5.55033	0.01106	274.42283	0.59410	34.89635
15YP04-024	330.18142	12.48443	332.84299	19.00965	351.48754	120.47566	0.05255	3.88250	0.38791	6.76152	0.05356	5.53574	0.00968	269.90558	0.55841	6.06170
15YP04-043	330.39300	11.01781	326.32964	17.28678	297.44375	115.03090	0.05259	3.42387	0.37904	6.24713	0.05230	5.22530	0.00978	270.86582	0.52745	-11.07747
15YP04-133	330.94745	13.80622	328.48302	21.17427	311.05846	137.51335	0.05268	4.28431	0.38197	7.62409	0.05261	6.30646	0.01114	280.24304	0.52985	-6.39397
15YP04-095	330.97453	12.49633	336.39940	20.66225	374.07318	133.26381	0.05268	3.87713	0.39278	7.28964	0.05410	6.17306	0.00977	275.33275	0.50797	11.52145
15YP04-083	331.05213	10.44907	328.43425	18.02285	309.92432	122.94875	0.05270	3.24069	0.38190	6.48010	0.05259	5.61156	0.00947	273.86308	0.46967	-6.81709
15YP04-080	331.17650	11.07703	332.63848	19.31227	342.87584	129.42024	0.05272	3.43435	0.38763	6.87376	0.05335	5.95431	0.00953	273.62499	0.45820	3.41212
15YP04-112	331.19776	11.28110	344.03742	20.46071	431.69573	131.66943	0.05272	3.49746	0.40330	7.08268	0.05551	6.15891	0.00959	277.20676	0.45107	23.27982
15YP04-063	331.45858	11.98237	326.89553	20.54830	294.52880	140.54946	0.05276	3.71223	0.37981	7.42683	0.05223	6.43251	0.01030	272.21045	0.45608	-12.53860
15YP04-029	331.65288	11.12610	328.24251	19.59683	304.13085	134.54532	0.05279	3.44475	0.38164	7.05499	0.05245	6.15683	0.00980	270.17280	0.44581	-9.04940
15YP04-046	331.66030	12.55853	324.51804	19.85232	273.58550	133.65043	0.05280	3.88859	0.37658	7.21737	0.05176	6.08023	0.00997	271.19178	0.50666	-21.22729
15YP04-084	331.75481	12.15142	331.05926	18.70795	326.17368	120.77153	0.05281	3.76137	0.38548	6.68351	0.05296	5.52462	0.01020	273.84043	0.53868	-1.71109
15YP04-102	331.78850	11.20774	336.29046	19.42348	367.54096	127.89003	0.05282	3.46867	0.39263	6.85028	0.05394	5.90717	0.00969	276.04949	0.46525	9.72748
15YP04-113	331.99481	10.83801	327.83858	19.19245	298.43478	132.40325	0.05285	3.35211	0.38109	6.91524	0.05232	6.04846	0.00999	277.71612	0.44887	-11.24535
15YP04-075	332.02999	10.99071	334.47070	19.61270	351.47880	131.46000	0.05286	3.39903	0.39014	6.94941	0.05356	6.06142	0.01050	273.07994	0.45546	5.53342
15YP04-129	332.13444	11.65776	333.09512	20.28437	339.80978	135.65488	0.05287	3.60441	0.38826	7.21486	0.05328	6.24999	0.01029	279.57455	0.45761	2.25872
15YP04-141	332.30343	12.83237	334.81125	20.36128	352.26958	130.63292	0.05290	3.96597	0.39060	7.21112	0.05358	6.02257	0.01180	281.45272	0.51266	5.66786
15YP04-117	332.58693	13.04024	348.17750	20.66741	453.53992	124.39272	0.05295	4.02694	0.40903	7.08349	0.05605	5.82749	0.01040	277.73730	0.54145	26.66865
15YP04-051	332.83012	11.99255	337.51382	19.92684	369.90856	128.75819	0.05299	3.70046	0.39431	7.00806	0.05400	5.95142	0.00999	271.38236	0.49712	10.02368
15YP04-097	333.34712	11.47214	325.41661	19.08893	269.06046	131.01424	0.05307	3.53439	0.37780	6.92096	0.05165	5.95044	0.01021	275.31185	0.47782	-23.89302
15YP04-072	333.42872	11.80855	332.70860	20.60131	327.67637	138.45612	0.05308	3.63726	0.38773	7.33593	0.05300	6.37073	0.00981	273.31047	0.43628	-1.75549
15YP04-086	333.51906	12.98843	339.65575	25.15645	381.87398	167.69299	0.05310	4.00000	0.39726	8.82300	0.05428	7.86418	0.00980	274.34237	0.37367	12.66253
15YP04-105	333.54230	11.14277	329.25911	19.41278	299.09492	132.77579	0.05310	3.43087	0.38302	6.96982	0.05234	6.06692	0.00967	276.13138	0.45721	-11.51721
15YP04-130	333.74148	12.68586	339.09148	21.57137	375.93672	139.50586	0.05314	3.90419	0.39648	7.56281	0.05414	6.47715	0.01116	279.58292	0.48584	11.22403
15YP04-060	333.89330	13.52842	329.24972	22.42873	296.55647	150.41399	0.05316	4.16192	0.38301	8.06485	0.05228	6.90798	0.01052	271.98118	0.48448	-12.59012
15YP04-078	334.08084	11.27268	332.75095	19.10682	323.46363	127.63526	0.05319	3.46546	0.38779	6.79800	0.05290	5.84837	0.00965	273.40172	0.47678	-3.28235
15YP04-104	334.16407	12.07465	333.80510	17.38104	331.30433	107.87533	0.05320	3.71133	0.38923	6.16223	0.05308	4.91926	0.01025	276.06673	0.57651	-0.86318
15YP04-036	334.28719	17.15658	341.32049	35.39166	389.49826	234.49623	0.05322	5.27352	0.39955	12.42454	0.05447	11.24986	0.01006	270.63803	0.41637	14.17492

Table 3 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP04: SGTHW Trans-Marine

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c		207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP04-056	334.78776	11.94795	336.76841	20.14076	350.46778	131.81403	0.05331	3.66568	0.39329	7.09726	0.05353	6.07732	0.01037	271.67403	0.48299	4.47403
15YP04-125	335.18729	12.50518	324.80874	24.53463	251.06516	175.76915	0.05337	3.83235	0.37697	8.93350	0.05125	8.06973	0.01080	279.56670	0.36575	-33.50610
15YP04-098	335.24793	11.78213	333.87649	20.51938	324.33264	137.63604	0.05338	3.60993	0.38933	7.28486	0.05292	6.32753	0.01012	275.96033	0.44079	-3.36546
15YP04-123	335.42060	11.55602	329.44355	19.10340	287.43416	128.90221	0.05341	3.53881	0.38327	6.85444	0.05207	5.87028	0.00990	278.52438	0.48848	-16.69476
15YP04-064	335.54556	12.61034	328.05808	21.85717	275.27060	150.20098	0.05343	3.86059	0.38139	7.88127	0.05179	6.87097	0.01048	272.27353	0.45967	-21.89662
15YP04-076	335.59124	13.01120	329.30080	20.82442	285.08064	138.68751	0.05344	3.98291	0.38308	7.48106	0.05202	6.33267	0.00993	273.32174	0.50119	-17.71800
15YP04-124	335.72354	11.06413	327.37823	20.02890	268.45949	140.22557	0.05346	3.38507	0.38046	7.22821	0.05164	6.38657	0.01044	279.18899	0.41191	-25.05557
15YP04-093	335.80707	11.57890	328.83536	19.60555	279.78248	133.76793	0.05347	3.54185	0.38244	7.04738	0.05190	6.09269	0.01039	275.35505	0.47158	-20.02434
15YP04-122	335.83777	12.50889	332.89265	20.93559	312.36205	139.34191	0.05348	3.82626	0.38798	7.45271	0.05264	6.39552	0.01102	278.81315	0.47142	-7.51555
15YP04-054	336.35533	14.96475	337.39981	23.16395	344.60442	146.14497	0.05356	4.57147	0.39415	8.16188	0.05339	6.76150	0.00980	271.62742	0.53400	2.39378
15YP04-135	336.49013	12.95420	329.40036	19.56002	279.60957	127.60483	0.05358	3.95512	0.38321	7.02064	0.05189	5.80055	0.01078	280.38900	0.54426	-20.34285
15YP04-069	336.65278	12.06373	335.32501	18.32949	326.12598	116.64153	0.05361	3.68126	0.39131	6.47665	0.05296	5.32872	0.00971	272.67879	0.53838	-3.22783
15YP04-091	336.73129	12.31378	324.86919	18.74137	240.70375	125.74689	0.05362	3.75678	0.37706	6.80349	0.05102	5.67222	0.00966	274.63506	0.52798	-39.89449
15YP04-137	336.75097	12.28867	338.81610	19.98822	353.01140	128.47580	0.05363	3.74890	0.39610	7.00708	0.05359	5.91988	0.01148	280.60055	0.51173	4.60621
15YP04-053	336.79161	12.55291	336.82380	20.99175	337.04603	137.41312	0.05363	3.82914	0.39336	7.39922	0.05322	6.33136	0.01012	271.44455	0.48695	0.07548
15YP04-099	337.07102	13.03296	337.79580	20.36683	342.78780	129.45919	0.05368	3.97251	0.39470	7.15931	0.05335	5.95608	0.00984	275.77364	0.51576	1.66773
15YP04-050	337.12254	12.24514	323.45423	21.43268	226.18409	151.52213	0.05369	3.73160	0.37514	7.81976	0.05070	6.87196	0.01090	271.48009	0.42883	-49.04785
15YP04-118	337.43299	12.34713	346.57268	19.04579	408.30077	115.67297	0.05374	3.75934	0.40681	6.54780	0.05493	5.36106	0.01084	277.79680	0.55324	17.35676
15YP04-110	337.61707	12.90596	330.57531	18.23459	281.30039	114.93475	0.05377	3.92757	0.38482	6.52095	0.05193	5.20548	0.01010	276.84160	0.58530	-20.02012
15YP04-139	337.83481	13.03766	332.93440	20.21048	298.83323	131.36002	0.05380	3.96520	0.38804	7.19124	0.05233	5.99927	0.01130	280.84199	0.52380	-13.05129
15YP04-089	338.05900	11.71383	330.48060	18.21958	277.45840	120.40814	0.05384	3.55991	0.38469	6.51711	0.05184	5.45892	0.00938	274.48039	0.51348	-21.84133
15YP04-025	339.71486	12.76641	324.29649	19.84315	215.01981	135.42382	0.05411	3.86169	0.37628	7.21818	0.05046	6.09832	0.00853	270.27190	0.49372	-57.99235
15YP04-040	340.12187	14.90641	341.18537	21.59202	348.43703	130.98558	0.05418	4.50451	0.39936	7.53100	0.05349	6.03534	0.01055	270.62049	0.57782	2.38642
15YP04-114	340.19325	13.57062	357.44408	22.65064	471.01813	135.74340	0.05419	4.09959	0.42195	7.60199	0.05650	6.40185	0.01169	278.41428	0.50559	27.77491
15YP04-136	341.72555	12.10424	340.55919	19.31540	332.60563	123.73745	0.05444	3.64022	0.39850	6.73978	0.05311	5.67216	0.01137	280.47344	0.51588	-2.74196
15YP04-023	341.79894	13.98657	345.25011	20.22463	368.54143	120.83281	0.05445	4.20605	0.40498	6.97948	0.05396	5.56977	0.01007	269.98494	0.58374	7.25630
15YP04-052	342.39312	14.77927	336.95667	20.39746	299.60668	124.01323	0.05455	4.43719	0.39355	7.18524	0.05235	5.65146	0.00982	271.47714	0.60180	-14.28087
15YP04-116	342.91464	12.37438	339.99739	18.53468	320.09891	116.28510	0.05463	3.70898	0.39773	6.47386	0.05282	5.30607	0.01006	277.51197	0.55532	-7.12771
15YP04-134	343.21600	13.43699	346.82499	22.14457	371.06969	139.49109	0.05468	4.02436	0.40716	7.62014	0.05402	6.47079	0.01165	280.36974	0.50900	7.50632
15YP04-140	344.10294	13.02363	333.90400	19.60699	263.44907	127.27200	0.05483	3.89065	0.38936	6.95732	0.05153	5.76777	0.01117	280.92208	0.53697	-30.61460
15YP04-014	348.15101	11.69854	355.24098	19.98920	401.83035	124.52557	0.05549	3.45488	0.41887	6.73461	0.05477	5.78090	0.01045	269.52243	0.47690	13.35871
15YP04-138	348.61628	12.84621	349.16844	22.70323	352.84281	146.40264	0.05557	3.78923	0.41041	7.77055	0.05359	6.78404	0.01204	281.00174	0.44489	1.19785
15YP04-013	351.98141	15.95101	366.35668	23.19958	458.36832	128.64911	0.05612	4.66239	0.43449	7.63030	0.05618	6.04017	0.01086	269.53209	0.59506	23.20992
15YP04-048	376.32597	18.37410	378.99092	23.95930	395.30621	124.65814	0.06012	5.03357	0.45245	7.66498	0.05461	5.78059	0.01210	271.22969	0.63945	4.80140
15YP04-003	382.03591	15.03278	398.77173	27.88265	496.95222	158.24141	0.06105	4.05739	0.48102	8.57194	0.05717	7.55088	0.01195	269.73486	0.43536	23.12422
15YP04-103	382.65260	21.27422	341.83951	27.20539	72.85956	170.82503	0.06116	5.73577	0.40026	9.49991	0.04749	7.57293	0.01101	276.66632	0.57578	-425.19205
15YP04-062	544.13328	17.88384	551.52706	26.46804	582.17824	110.80591	0.08807	3.43209	0.72146	6.30159	0.05944	5.28496	0.01890	271.87610	0.52688	6.53493
15YP04-031	574.00243	20.11643	572.95423	27.55340	568.79796	109.69851	0.09313	3.66865	0.75817	6.37889	0.05907	5.21835	0.01783	270.16169	0.56212	-0.91500
15YP04-108	579.87745	21.57561	567.50950	33.68959	518.25161	143.64526	0.09412	3.89709	0.74877	7.87908	0.05772	6.84781	0.01811	276.72786	0.45467	-11.89110
15YP04-022	583.97070	24.63605	596.74199	45.51928	645.58573	188.56992	0.09482	4.42112	0.79985	10.31728	0.06121	9.32202	0.01781	270.08189	0.34942	9.54405
15YP04-057	584.85280	21.84323	572.20309	28.51206	522.26243	112.78230	0.09497	3.91344	0.75687	6.61041	0.05783	5.32753	0.01861	271.70993	0.57698	-11.98447
15YP04-049	591.57829	22.33316	610.92144	32.46056	683.30956	123.12150	0.09611	3.95791	0.82516	7.18539	0.06230	5.99706	0.01781	271.10340	0.51280	13.42456
15YP04-082	606.82601	28.99233	596.30838	41.82872	556.50246	166.12693	0.09871	5.01737	0.79908	9.46851	0.05874	8.02986	0.01890	273.72223	0.49452	-9.04283
15YP04-101	622.02383	22.66230	606.08057	31.92224	546.90990	125.66224	0.10130	3.82864	0.81648	7.10550	0.05848	5.98578	0.01811	275.63450	0.50825	-13.73424
15YP04-090	631.77691	21.69918	618.53778	30.01855	570.38155	115.31447	0.10297	3.61176	0.83890	6.57724	0.05912	5.49684	0.01844	274.36131	0.52007	-10.76391
15YP04-007	636.02929	22.07889	633.60253	29.67643	624.95412	109.17946	0.10370	3.65168	0.86639	6.38902	0.06062	5.24259	0.01660	269.27387	0.55127	-1.77216
15YP04-131	678.39234	25.54110	656.59093	40.54680	582.38721	156.52695	0.11097	3.97439	0.90912	8.55536	0.05944	7.57617	0.02115	279.74797	0.40572	-16.48476
15YP04-132	684.35769	27.66406	649.59885	31.69040	530.60655	109.48991	0.11200	4.26986	0.89602	6.70838	0.05805	5.17404	0.02329	279.87995	0.62226	-28.97649
15YP04-044	697.46987	28.21897	751.60188	37.61248	916.29037	115.16474	0.11427	4.27808	1.09639	7.21570	0.06962	5.81071	0.02494	270.97279	0.57002	23.88113
15YP04-010	1049.30088	33.02282	1036.40743	36.75868	1009.30727	91.33871	0.17677	3.41895	1.77515	5.76323	0.07287	4.63957	0.02789	269.32251	0.58353	-3.96248
15YP04-066	1156.10326	41.04712	1329.96174	47.54316	1622.11052	95.29804	0.19643	3.89073	2.70548	6.56546	0.09994	5.28843	0.04470	272.23803	0.56037	28.72845
15YP04-120	3375.75482	97.45705	3395.25082	55.38170	3406.77602	67.58860	0.68820	3.73672	27.32693	5.81089	0.28812	4.45010	0.11252	278.14500	0.63671	0.91057

a Isotopic dates calculated using λ238 = 1.55125E-10 (Jaffey et al. 1971) and λ235 = 9.8485E-10 (Jaffey et al. 1971).
b % discordance = 100 - (100 * (206Pb/238U date) / (207Pb/206Pb date))
c Measured ratios corrected for fractionation, tracer, blank and initial common Pb.

Table 3: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP07 &15YP11: SGTFW volcanic

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP07																
15YP07-034	45.64062	2.26588	51.26575	6.33522	322.82873	245.83872	0.00711	4.98308	0.05179	12.71180	0.05288	11.69439	0.00225	12.27962	0.28945	85.86228
15YP07-044	45.96306	2.55539	45.22673	6.38059	6.35156	293.53037	0.00716	5.58060	0.04555	14.46995	0.04619	13.35051	0.00216	15.66025	0.26854	-623.64944
15YP07-026	46.20209	3.15054	68.60376	11.36961	942.38950	294.24369	0.00719	6.84517	0.06990	17.23536	0.07051	15.81775	0.00368	22.42560	0.20209	95.09735
15YP07-018	46.20273	2.55786	55.69785	9.63063	485.90180	336.29204	0.00719	5.55714	0.05639	17.85396	0.05688	16.96709	0.00225	22.73422	0.18384	90.49134
15YP07-052	46.77974	2.68176	84.39769	9.65773	1345.11674	190.47492	0.00728	5.75476	0.08667	11.98218	0.08635	10.50977	0.00233	16.83426	0.33569	96.52225
15YP07-027	46.91920	2.97420	58.73229	10.11488	571.60980	325.91413	0.00730	6.36354	0.05955	17.81347	0.05915	16.63806	0.00446	19.50425	0.19839	91.79174
15YP07-024	47.05183	3.63355	62.18525	16.25718	692.23684	475.14214	0.00733	7.75284	0.06316	27.16877	0.06256	26.03912	0.00283	27.48326	0.14921	93.20293
15YP07-028	47.41989	3.76302	53.21659	9.82045	322.68006	351.22823	0.00738	7.96707	0.05381	19.03344	0.05288	17.28576	0.00288	15.05620	0.34155	85.30436
15YP07-049	47.67693	2.70323	57.83520	8.27751	501.76316	275.11617	0.00742	5.69209	0.05861	14.78388	0.05729	13.64416	0.00285	18.50730	0.24412	90.49812
15YP07-060	47.69700	2.54797	61.70740	10.41094	645.96156	322.09056	0.00743	5.36284	0.06266	17.47876	0.06122	16.63571	0.00310	14.35477	0.16633	92.61612
15YP07-047	48.01464	3.14586	54.97805	8.06716	370.01772	280.88407	0.00748	6.57791	0.05564	15.13429	0.05400	13.63003	0.00287	20.97425	0.32265	87.02369
15YP07-042	48.06405	2.74610	53.53472	6.45688	305.79043	233.27243	0.00748	5.73596	0.05414	12.42130	0.05249	11.01760	0.00229	10.32558	0.36746	84.28203
15YP07-029	48.11226	2.97585	63.52139	11.29042	691.28603	332.39522	0.00749	6.20977	0.06456	18.43829	0.06253	17.36114	0.00390	24.74113	0.20347	93.04018
15YP07-021	48.29549	2.95578	70.26101	13.25621	901.73342	343.81720	0.00752	6.14456	0.07165	19.65541	0.06913	18.67028	0.00323	16.51380	0.15980	94.64415
15YP07-056	48.43828	2.42828	55.60629	8.32542	376.44970	298.90093	0.00754	5.03295	0.05629	15.44904	0.05415	14.60624	0.00253	16.93197	0.19910	87.13287
15YP07-012	48.45771	2.66643	57.83022	9.18042	465.56234	309.94241	0.00755	5.52444	0.05861	16.40519	0.05636	15.44703	0.00246	18.88313	0.22136	89.59158
15YP07-006	48.68079	2.88052	55.59367	8.07934	364.63399	283.71969	0.00758	5.94085	0.05628	14.99389	0.05387	13.76674	0.00234	14.84622	0.30891	86.64941
15YP07-054	48.68844	2.59947	62.08150	8.89064	614.90009	273.45821	0.00758	5.36026	0.06305	14.82800	0.06034	13.82524	0.00325	21.62142	0.20013	92.08189
15YP07-007	48.72308	2.84629	52.02332	7.80339	206.81458	301.52073	0.00759	5.86517	0.05257	15.44660	0.05028	14.28977	0.00280	26.32077	0.26184	76.44118
15YP07-040	48.76501	2.83346	63.48964	10.38787	661.26611	308.96340	0.00759	5.83373	0.06452	16.96501	0.06166	15.93045	0.00290	16.92490	0.24030	92.62551
15YP07-017	48.88554	3.13326	64.04740	12.59054	675.27904	367.54814	0.00761	6.43527	0.06511	20.41096	0.06206	19.36994	0.00302	22.48780	0.17937	92.76069
15YP07-005	49.07602	3.44042	52.12680	7.69244	194.72519	286.23257	0.00764	7.03899	0.05268	15.19670	0.05002	13.46820	0.00218	16.07941	0.40058	74.79729
15YP07-039	49.10736	2.70189	50.11251	7.55529	98.45853	311.21956	0.00765	5.52415	0.05059	15.50938	0.04800	14.49223	0.00254	15.50141	0.27631	50.12382
15YP07-036	49.14259	2.92681	51.83514	7.17554	178.15816	276.59628	0.00765	5.97985	0.05238	14.24964	0.04966	12.93420	0.00281	12.44958	0.31165	72.41631
15YP07-053	49.36355	2.56687	49.98615	6.48901	79.94490	268.34596	0.00769	5.22090	0.05046	13.34638	0.04763	12.28284	0.02394	4.65526	0.31549	38.25304
15YP07-032	49.62682	4.14153	58.86260	14.52526	452.87092	462.24818	0.00773	8.38021	0.05968	25.58125	0.05604	24.16967	0.00318	19.42251	0.22318	89.04173
15YP07-037	49.68774	2.70889	55.01392	7.94812	293.56750	288.88890	0.00774	5.47401	0.05568	14.90063	0.05221	13.85871	0.00263	17.17639	0.27045	83.07451
15YP07-035	49.68951	3.10884	54.02170	7.63340	250.63848	277.13745	0.00774	6.28219	0.05464	14.56415	0.05124	13.13958	0.00268	19.23454	0.31388	80.17483
15YP07-004	49.71574	3.30907	49.16169	5.66319	22.22707	219.11312	0.00774	6.68339	0.04961	11.83360	0.04649	9.76557	0.00241	14.81636	0.51635	-123.67198
15YP07-001	50.09851	3.33337	51.64797	7.54874	124.14816	290.04235	0.00780	6.68125	0.05218	15.04649	0.04853	13.48175	0.00238	22.59562	0.34608	59.64619
15YP07-057	50.50581	2.75665	64.76387	9.45173	629.66818	277.92705	0.00787	5.48068	0.06586	15.13484	0.06076	14.10764	0.00241	13.77421	0.25842	91.97898
15YP07-014	50.60696	2.36245	50.94071	6.52577	66.67165	269.62816	0.00788	4.68744	0.05145	13.17685	0.04737	12.31492	0.00239	14.93711	0.28382	24.09524
15YP07-030	51.07773	3.43808	54.13685	7.47587	191.70441	267.90920	0.00795	6.75957	0.05476	14.23293	0.04995	12.52536	0.00264	14.33940	0.40152	73.35599
15YP07-045	51.23374	2.95465	60.62675	10.01050	449.35276	322.33121	0.00798	5.79128	0.06153	17.09367	0.05595	16.08274	0.00376	18.79515	0.15972	88.59833
15YP07-003	51.70473	3.49990	52.87142	7.09946	106.07226	262.27772	0.00805	6.79805	0.05345	13.82869	0.04816	12.04240	0.00216	14.95291	0.43698	51.25518
15YP07-025	52.16839	3.34219	48.72367	8.88603	-117.67212	385.73728	0.00813	6.43418	0.04916	18.76063	0.04390	17.62279	0.00245	26.64627	0.20916	144.33369

Table 3 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP07 &15YP11: SGTFW volcanic

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP11																
15YP11-022	47.45103	4.15216	77.36612	20.29293	1139.77256	446.41474	0.00739	8.78548	0.07917	27.51574	0.07776	26.07549	0.00393	35.71189	0.14856	95.83680
15YP11-081	47.98098	3.51600	62.53335	13.56997	662.58742	400.44584	0.00747	7.35721	0.06352	22.52563	0.06169	21.29027	0.00379	19.88684	0.00000	92.75854
15YP11-122	48.63294	2.97337	59.47468	8.14749	521.19251	257.87789	0.00757	6.13841	0.06032	14.16095	0.05780	12.76137	0.00260	19.32533	0.23205	90.66891
15YP11-097	49.18442	3.76471	55.26266	11.18381	327.38329	389.80365	0.00766	7.68576	0.05593	20.90821	0.05299	19.44434	0.00310	24.45023	0.23727	84.97650
15YP11-005	49.78620	3.31117	63.09214	9.48918	602.51089	278.65288	0.00775	6.67821	0.06411	15.58501	0.06000	14.08170	0.00265	17.08182	0.29357	91.73688
15YP11-058	49.84220	2.94711	60.82860	9.85386	517.96116	311.61595	0.00776	5.93712	0.06174	16.77070	0.05771	15.68461	0.00316	17.68408	0.13827	90.37723
15YP11-052	49.94135	2.79143	48.98308	7.21489	2.33055	308.01805	0.00778	5.61231	0.04942	15.14122	0.04611	14.06267	0.00222	9.43318	0.39985	-2042.90371
15YP11-001	49.94680	2.31800	50.76565	4.37593	89.59826	169.41690	0.00778	4.65978	0.05127	8.85622	0.04783	7.53121	0.00249	7.87493	0.46407	44.25472
15YP11-061	50.13504	2.51603	54.86037	6.62273	266.40327	241.93459	0.00781	5.03903	0.05552	12.44156	0.05159	11.37543	0.00242	13.61859	0.32609	81.18077
15YP11-043	50.14515	3.48490	71.16336	16.07512	850.98216	409.05483	0.00781	6.97858	0.07260	23.57599	0.06746	22.51948	0.00335	21.56460	0.11982	94.10738
15YP11-125	50.18287	3.01469	62.94147	9.89722	579.88968	298.76878	0.00781	6.03223	0.06395	16.29617	0.05937	15.13861	0.00258	13.88954	0.20853	91.34613
15YP11-051	50.40099	3.27989	67.78540	12.77039	734.72224	349.19170	0.00785	6.53473	0.06904	19.59827	0.06382	18.47673	0.00374	27.95581	0.11121	93.14013
15YP11-101	50.40935	4.01304	63.72210	10.49166	597.66435	297.01395	0.00785	7.99455	0.06477	17.07481	0.05986	15.08762	0.00285	17.94109	0.23836	91.56561
15YP11-138	50.41594	3.10434	54.29027	9.48075	228.78813	350.10406	0.00785	6.18305	0.05492	18.01808	0.05076	16.92398	0.00265	23.28280	0.16189	77.96392
15YP11-137	50.42621	5.01160	115.09620	25.13401	1813.40840	341.47515	0.00785	9.98128	0.12003	23.38668	0.11090	21.14973	0.00261	28.67196	0.00000	97.21926
15YP11-018	50.50381	3.63295	60.65109	12.09240	482.18008	378.62284	0.00787	7.22367	0.06155	20.66183	0.05678	19.35794	0.00254	17.78896	0.21808	89.52594
15YP11-049	50.51423	3.42123	88.10822	14.56125	1282.63129	283.38819	0.00787	6.80117	0.09065	17.37826	0.08361	15.99212	0.00312	28.65500	0.16491	96.06167
15YP11-026	50.52918	3.37971	68.55635	11.78102	754.05179	315.55394	0.00787	6.71664	0.06985	17.87458	0.06441	16.56464	0.00377	23.86395	0.18972	93.29898
15YP11-091	50.61103	2.98141	53.61022	7.34468	189.79336	273.73261	0.00788	5.91535	0.05422	14.11599	0.04991	12.81678	0.00247	13.55046	0.30555	73.33362
15YP11-044	50.73248	5.02843	65.75557	14.49382	653.73724	390.36532	0.00790	9.95460	0.06690	22.92662	0.06144	20.65275	0.00383	25.45805	0.30659	92.23962
15YP11-012	50.79094	3.55590	66.53542	16.10174	677.34221	446.97476	0.00791	7.03060	0.06772	25.20108	0.06212	24.20052	0.00400	22.17099	0.15943	92.50144
15YP11-108	50.85823	2.96610	59.46589	9.97966	421.46164	328.59102	0.00792	5.85647	0.06031	17.36356	0.05525	16.34610	0.00292	18.23694	0.22235	87.93289
15YP11-118	50.89498	3.97912	58.97900	9.49547	400.91417	299.09822	0.00793	7.85163	0.05981	16.64958	0.05475	14.68198	0.00201	24.01874	0.28583	87.30527
15YP11-070	50.95971	3.68798	56.27659	11.94270	288.87080	414.68917	0.00794	7.26778	0.05699	21.94375	0.05210	20.70526	0.00281	20.48049	0.29998	82.35900
15YP11-045	50.97509	3.21888	59.55210	9.49201	419.64747	308.10078	0.00794	6.34119	0.06040	16.48793	0.05521	15.21976	0.00279	19.27601	0.28045	87.85288
15YP11-060	51.03959	4.06925	68.38988	11.14273	727.38872	288.27026	0.00795	8.00686	0.06967	16.94059	0.06360	14.92896	0.00368	17.54951	0.02801	92.98318
15YP11-146	51.04900	3.21786	53.61373	8.76709	169.78664	329.13602	0.00795	6.33004	0.05422	16.86051	0.04948	15.62714	0.00262	18.98017	0.16496	69.93344
15YP11-032	51.08688	2.86287	57.57125	6.60923	336.39650	220.40439	0.00796	5.62741	0.05834	11.84714	0.05320	10.42530	0.00271	18.42587	0.34173	84.81349
15YP11-010	51.14308	4.38343	58.38429	11.79254	366.50623	380.34092	0.00797	8.60789	0.05919	20.90556	0.05392	19.05116	0.00334	21.36203	0.27206	86.04578
15YP11-002	51.25225	3.76759	66.76032	11.84220	665.37958	325.59368	0.00798	7.38249	0.06796	18.43521	0.06178	16.89248	0.00329	20.04816	0.26987	92.29729
15YP11-034	51.30284	3.52318	54.09595	6.72056	179.61803	233.68795	0.00799	6.89666	0.05472	12.79959	0.04969	10.78265	0.00218	20.07855	0.44454	71.43781
15YP11-014	51.32277	4.05346	54.17158	11.51938	182.05223	418.10461	0.00799	7.93196	0.05480	21.96124	0.04974	20.47877	0.00312	20.53015	0.22738	71.80876
15YP11-113	51.32392	3.28159	51.38307	7.85336	54.14288	311.15491	0.00799	6.42100	0.05191	15.73469	0.04712	14.36493	0.00230	14.91764	0.30173	5.20651
15YP11-038	51.36952	3.42273	63.23268	9.30288	539.12007	274.44379	0.00800	6.69133	0.06425	15.24471	0.05827	13.69771	0.00295	15.28255	0.28654	90.47160
15YP11-077	51.38541	3.91057	63.24103	11.66653	538.73901	343.66836	0.00800	7.64296	0.06426	19.13791	0.05826	17.54551	0.00318	19.31559	0.23074	90.46191
15YP11-147	51.38811	2.92273	60.20231	10.88197	426.52207	354.90643	0.00800	5.71156	0.06108	18.71694	0.05538	17.82419	0.00267	18.59228	0.34142	87.95183
15YP11-133	51.40643	2.66613	56.05753	5.71279	259.60828	197.05196	0.00801	5.20815	0.05676	10.50437	0.05144	9.12233	0.00231	8.84978	0.41547	80.19846
15YP11-036	51.41097	3.16526	57.23596	8.90959	308.32786	306.79544	0.00801	6.18289	0.05799	16.07971	0.05255	14.84348	0.00390	14.94252	0.22950	83.32588
15YP11-007	51.48568	3.40446	66.39385	14.28687	643.38966	403.10064	0.00802	6.64064	0.06757	22.38668	0.06115	21.37908	0.00367	19.55674	0.17695	91.99775
15YP11-104	51.50450	3.54701	55.83226	10.00869	245.68780	353.73900	0.00802	6.91624	0.05653	18.51482	0.05113	17.17452	0.00318	20.60949	0.28207	79.03661
15YP11-085	51.51986	3.41905	50.74981	7.98515	14.53071	321.16465	0.00802	6.66470	0.05125	16.19443	0.04634	14.75945	0.00274	20.53174	0.32053	-254.55851
15YP11-074	51.57260	4.00387	54.74510	9.89016	195.87657	352.36368	0.00803	7.79709	0.05540	18.64789	0.05004	16.93958	0.00376	31.00543	-0.03809	73.67087
15YP11-121	51.77113	3.68668	73.97359	15.42882	867.78085	376.94120	0.00806	7.15179	0.07557	21.79132	0.06800	20.58431	0.00443	24.39260	0.13726	94.03408
15YP11-114	51.77371	2.67619	49.58268	5.41370	-55.11211	226.02175	0.00806	5.19088	0.05004	11.21715	0.04503	9.94380	0.00228	11.89912	0.35675	193.94252
15YP11-062	51.81515	4.09397	76.24905	15.80770	930.85171	367.05312	0.00807	7.93543	0.07799	21.68821	0.07012	20.18433	0.00473	21.08166	0.34317	94.43358
15YP11-090	51.82991	3.09823	69.50884	11.72396	730.26918	315.46610	0.00807	6.00320	0.07085	17.55189	0.06369	16.49335	0.00355	22.66672	0.26631	92.90263
15YP11-023	51.87511	3.27790	64.73391	11.31439	570.48682	332.29575	0.00808	6.34591	0.06583	18.14227	0.05912	16.99622	0.00227	15.83905	0.24893	90.90687
15YP11-047	51.88335	3.00010	57.31599	7.74336	290.66032	266.41169	0.00808	5.80705	0.05807	13.94794	0.05214	12.68161	0.00264	14.38470	0.32518	82.14983
15YP11-021	51.90597	3.69561	65.33214	13.68669	589.81948	392.83497	0.00808	7.15058	0.06646	21.77703	0.05965	20.56960	0.00347	18.57295	0.18746	91.19968
15YP11-093	51.95637	3.25493	51.59946	8.58524	35.05341	343.06445	0.00809	6.29161	0.05213	17.13691	0.04674	15.94018	0.00319	21.14626	0.00000	-48.22058
15YP11-131	52.02983	3.39744	61.94334	12.09970	464.12367	376.35034	0.00810	6.55791	0.06290	20.25583	0.05632	19.16488	0.00317	20.82177	0.24993	88.78966
15YP11-132	52.08261	3.55492	60.80736	9.56476	419.43186	299.78632	0.00811	6.85505	0.06172	16.28187	0.05520	14.76846	0.00246	21.68302	0.19088	87.58258
15YP11-109	52.10869	3.12866	55.14574	10.27057	189.15116	377.30626	0.00812	6.02987	0.05581	19.23183	0.04990	18.26210	0.00215	17.76791	0.55711	72.45130
15YP11-080	52.11649	3.80482	66.72572	10.81864	628.16195	296.91307	0.00812	7.33233	0.06792	16.84173	0.06071	15.16182	0.00341	19.60030	0.21121	91.70334
15YP11-098	52.14195	3.19026	59.68961	7.38232	374.02934	234.28082	0.00812	6.14471	0.06055	12.78134	0.05410	11.20737	0.00290	16.82181	0.39801	86.05940
15YP11-088	52.14745	2.94013	59.22003	8.16546	355.45749	271.08972	0.00812	5.66223	0.06006	14.25157	0.05365	13.07847	0.00260	13.42438	0.26561	85.32948
15YP11-134	52.23807	2.59853	50.07782	4.87613	-52.14750	198.56142	0.00814	4.99558	0.05056	10.00319	0.04508	8.66648	0.00234	13.70488	0.31359	200.17368
15YP11-117	52.28115	3.28839	65.05409	12.05425	564.53264	353.29762	0.00814	6.31697	0.06617	19.24349	0.05896	18.17713	0.00356	25.64535	0.36839	90.73904
15YP11-107	52.36876	3.26556	63.44088	9.25998	504.12202	277.30820	0.00816	6.26265	0.06447	15.12583	0.05735	13.76844	0.00252	16.88187	0.24351	89.61189
15YP11-148	52.44138	4.33044	60.92743	11.68943	408.56854	360.31333	0.00817	8.29409	0.06184	19.88142	0.05493	18.06873	0.00364	21.11497	0.02846	87.16461
15YP11-039	52.50651	3.55662	74.63789	15.38641	857.63525	375.18755	0.00818	6.80318	0.07628	21.54451	0.06767	20.44218	0.00415	31.60148	0.16009	93.87776
15YP11-068	52.55212	3.73438	57.87590	6.27840	284.12352	186.10571	0.00819	7.13712	0.05865	11.19471	0.05199	8.62457	0.00247	10.15820	0.36033	81.50378
15YP11-140	52.65806	2.97625	54.82415	8.91611	150.53138	333.34917	0.00820	5.67645	0.05548	16.77967	0.04908	15.79036	0.00247	16.31358	0.24919	65.01855
15YP11-027	52.66595	3.98688	125.12104	20.06450	1894.58737	254.48238	0.00820	7.60344	0.13114	17.21390	0.11599	15.44364	0.00324	19.01999	0.27576	97.22019
15YP11-041	52.74900	5.42805	84.24485	21.45937	1104.58487	428.74880	0.00822	10.33685	0.08651	26.82642	0.07640	24.75493	0.00530	28.44892	0.21271	95.22454
15YP11-112	52.82076	3.01620	57.16696	6.59938	243.26982	224.23587	0.00823	5.73503	0.05792	11.91072	0.05108	10.43910	0.00325	19.69803	0.31492	78.28717
15YP11-017	52.91938	4.01811	54.39086	8.22836	119.69639	292.77252	0.00824	7.62647	0.05503	15.60014	0.04844	13.60887	0.00241	13.62022	0.37009	55.78866
15YP11-025	52.95767	3.08636	54.16896	7.73658	108.07765	291.40269	0.00825	5.85335	0.05480	14.72269	0.04820	13.50910	0.00226	12.23002	0.29658	51.00035
15YP11-056	52.98719	3.62758	76.05173	14.85150	879.02549	354.11365	0.00825	6.87626	0.07778	20.41756	0.06838	19.22482	0.00388	19.63284	0.38018	93.97205
15YP11-054	53.00506	3.25626	73.24039	16.02608	796.95527	404.12756	0.00826	6.17015	0.07480	22.86005	0.06573	22.01162	0.00383	16.89473	0.16031	93.34905
15YP11-015	53.00858	3.89804	71.63179	12.18048	748.39084	307.86032	0.00826	7.38610	0.07309	17.71719	0.06423	16.10417	0.00300	29.82494	0.24774	92.91699

Table 3 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP07 &15YP11: SGTFW volcanic

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP11-129	53.15942	3.23367	67.56511	12.93879	613.11068	364.10149	0.00828	6.10961	0.06881	19.92097	0.06029	18.96095	0.00294	17.36160	0.15631	91.32956
15YP11-111	53.23882	3.33285	59.25446	10.73103	309.65729	358.74794	0.00829	6.28769	0.06009	18.74250	0.05258	17.65634	0.00265	21.73733	0.25263	82.80718
15YP11-120	53.36947	3.15941	61.40465	11.07472	387.10528	355.27529	0.00831	5.94587	0.06234	18.68822	0.05441	17.71711	0.01547	9.81997	0.25711	86.21319
15YP11-079	53.47684	3.97844	68.73605	14.66632	638.52110	395.98213	0.00833	7.47276	0.07004	22.22765	0.06101	20.93386	0.00442	28.78874	0.22721	91.62489
15YP11-011	53.50281	4.06149	62.29698	13.22952	414.80714	405.73724	0.00833	7.62512	0.06327	22.03759	0.05509	20.67638	0.00264	18.05500	0.21937	87.10176
15YP11-006	53.58029	3.33528	61.12477	10.28742	367.60984	330.12216	0.00835	6.25234	0.06205	17.43001	0.05394	16.27002	0.00320	15.36254	0.23748	85.42469
15YP11-119	53.73106	4.48300	75.37809	15.71867	830.77116	371.55901	0.00837	8.38113	0.07706	21.80504	0.06681	20.12998	0.00572	28.24274	0.04585	93.53239
15YP11-013	53.80738	2.58704	58.40712	6.74843	251.31670	233.28767	0.00838	4.82903	0.05921	11.92922	0.05126	10.90811	0.00251	11.84551	0.29488	78.58981
15YP11-136	53.81079	3.43513	60.96912	10.52152	351.95482	338.54772	0.00838	6.41211	0.06188	17.87287	0.05357	16.68305	0.00242	16.71286	0.38303	84.71088
15YP11-110	53.90462	3.16058	58.34843	11.46614	244.76149	395.56050	0.00840	5.88927	0.05915	20.33579	0.05111	19.46435	0.00312	20.19812	0.21915	77.97668
15YP11-145	53.94040	3.58561	62.31080	13.42688	397.01076	418.44294	0.00840	6.67707	0.06329	22.36371	0.05465	21.34367	0.00323	15.31402	0.20213	86.41337
15YP11-149	54.01024	2.90730	61.83898	10.92644	376.49555	351.88585	0.00841	5.40667	0.06279	18.31102	0.05415	17.49461	0.00272	16.88062	0.38795	85.65448
15YP11-064	54.04975	6.64465	93.83525	27.16814	1278.56331	467.92730	0.00842	12.35155	0.09682	30.72061	0.08344	28.12819	0.00840	29.42995	0.00000	95.77262
15YP11-040	54.05276	5.15522	76.00875	17.49235	836.29797	403.30263	0.00842	9.58125	0.07773	24.09265	0.06698	22.10555	0.00426	25.98397	0.23596	93.53666
15YP11-046	54.10189	3.71030	62.83498	10.65652	409.63127	326.13252	0.00843	6.88878	0.06384	17.58180	0.05496	16.17604	0.00258	18.99954	0.27287	86.79254
15YP11-059	54.28866	3.30099	62.44390	14.45387	387.44659	451.59625	0.00846	6.10764	0.06343	24.03668	0.05442	23.24777	0.00364	16.57356	0.34681	85.98809
15YP11-069	54.30949	4.12190	60.43256	11.03746	310.29158	352.41686	0.00846	7.62410	0.06132	18.91563	0.05259	17.31109	0.00330	20.71014	0.17584	82.49727
15YP11-082	54.41693	4.80699	63.53464	9.34131	422.12363	254.98961	0.00848	8.87427	0.06457	15.23747	0.05527	12.38660	0.00374	15.96013	0.29460	87.10877
15YP11-003	54.48317	3.83810	66.78958	13.10946	533.44608	371.89134	0.00849	7.07648	0.06799	20.41210	0.05812	19.14621	0.00325	24.48283	0.21658	89.78656
15YP11-123	54.52228	3.89428	63.73091	13.58805	424.89011	409.80518	0.00849	7.17495	0.06478	22.14492	0.05534	20.95036	0.00313	23.92003	0.00000	87.16791
15YP11-057	54.56641	5.02909	62.60762	12.07558	381.99898	355.90798	0.00850	9.25912	0.06360	20.00719	0.05429	17.73574	0.00307	22.05210	0.05865	85.71556
15YP11-124	54.81339	3.45839	70.20450	10.54960	632.23697	281.12248	0.00854	6.33795	0.07159	15.63350	0.06083	14.29114	0.00319	21.91221	0.20548	91.33025
15YP11-102	55.02364	5.37015	99.18115	29.68674	1356.39420	494.23851	0.00857	9.80550	0.10261	31.88126	0.08685	30.33590	0.00321	26.22545	-0.04081	95.94339
15YP11-055	55.02889	3.16843	62.18860	9.58611	347.27958	305.52341	0.00857	5.78378	0.06316	15.96670	0.05346	14.88231	0.00341	16.24894	0.22943	84.15430
15YP11-075	55.15390	4.21196	53.47327	6.21770	-21.20469	208.67851	0.00859	7.67197	0.05407	11.97316	0.04566	9.19225	0.00285	14.98691	0.35565	360.10232
15YP11-019	55.26077	2.51260	58.99599	6.16462	213.36072	211.94651	0.00861	4.56721	0.05982	10.78844	0.05042	9.77400	0.00238	10.95472	0.30665	74.09984
15YP11-086	55.27058	2.65395	55.74989	5.43459	76.39389	197.00716	0.00861	4.82335	0.05644	10.04508	0.04756	8.81130	0.00279	8.71383	0.35532	27.65053

a Isotopic dates calculated using λ238 = 1.55125E-10 (Jaffey et al. 1971) and λ235 = 9.8485E-10 (Jaffey et al. 1971).
b % discordance = 100 - (100 * (206Pb/238U date) / (207Pb/206Pb date))
c Measured ratios corrected for fractionation, tracer, blank and initial common Pb.

Table 4: LA-ICP-MS Zircon Isotopic and Age Data Table: 15G001: Murdunu-Goynuk volcanic

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15G001																
15G1-069	71.64040	5.55840	70.65731	6.07350	37.50734	100.45457	0.01118	7.80530	0.07207	8.92492	0.04679	4.32798	0.00321	21.25453	0.87140	-91.00370
15G1-056	73.23392	5.71751	77.85820	11.12078	222.20420	269.60925	0.01143	7.85511	0.07970	14.91954	0.05061	12.68424	0.00340	24.35878	0.48073	67.04206
15G1-049	74.03874	5.52419	82.10409	10.42430	323.55643	231.43697	0.01155	7.50735	0.08422	13.28475	0.05290	10.96012	0.00345	22.59370	0.53514	77.11721
15G1-062	74.31274	6.17132	94.25040	15.39691	633.70196	295.11154	0.01159	8.35648	0.09727	17.23644	0.06087	15.07528	0.00460	28.41613	0.41016	88.27324
15G1-035	74.78218	5.39256	75.97376	7.17021	113.62420	149.42975	0.01167	7.25596	0.07769	9.82990	0.04831	6.63159	0.00318	21.58237	0.72177	34.18464
15G1-058	75.12693	5.60480	76.99781	8.18363	135.46019	181.09795	0.01172	7.50726	0.07878	11.08106	0.04876	8.15052	0.00401	20.97780	0.65913	44.53947
15G1-063	75.13139	5.80940	88.45248	12.57585	464.66516	260.08704	0.01172	7.78098	0.09102	14.93821	0.05634	12.75172	0.00362	23.92104	0.46365	83.83107
15G1-027	75.31949	5.44927	78.85881	7.03847	187.46258	129.70870	0.01175	7.28029	0.08076	9.30871	0.04986	5.80082	0.00318	21.22155	0.76901	59.82159
15G1-089	75.33653	5.73397	82.03158	9.62458	281.61845	205.69590	0.01176	7.65911	0.08414	12.27116	0.05194	9.58746	0.00331	23.12278	0.59684	73.24872
15G1-034	75.41464	5.64023	112.10771	10.57073	984.47426	128.87273	0.01177	7.52608	0.11674	10.01121	0.07198	6.60170	0.00435	20.93165	0.72177	92.33960
15G1-026	75.46599	5.86489	80.58209	11.11526	235.02352	258.02476	0.01178	7.82070	0.08260	14.42711	0.05089	12.12346	0.00296	22.79308	0.49605	67.89003
15G1-082	75.53198	5.71282	73.50529	7.50086	8.07197	169.16545	0.01179	7.61122	0.07508	10.61750	0.04622	7.40274	0.00401	20.61442	0.70425	-835.73178
15G1-059	75.64037	6.07951	81.84022	9.47954	266.77219	194.64784	0.01180	8.08845	0.08394	12.11250	0.05160	9.01607	0.00312	22.06847	0.64452	71.64608
15G1-083	75.65434	5.65318	76.04306	8.74566	88.27841	207.59736	0.01181	7.51961	0.07777	11.98852	0.04780	9.33702	0.00326	22.36142	0.59532	14.30029
15G1-061	75.66797	5.80539	79.07145	11.04019	183.16852	265.48160	0.01181	7.72079	0.08099	14.59218	0.04977	12.38229	0.00320	24.82363	0.48274	58.68943
15G1-012	76.03287	5.47556	78.44885	7.85077	152.67319	167.14156	0.01186	7.24720	0.08032	10.43937	0.04912	7.51390	0.00333	22.35132	0.67320	50.19894
15G1-095	76.04787	5.70004	88.38770	12.26554	435.87839	256.07404	0.01187	7.54297	0.09095	14.57760	0.05561	12.47437	0.00314	22.66703	0.48572	82.55296
15G1-060	76.17139	5.92910	79.33342	11.01416	175.63478	262.52265	0.01189	7.83358	0.08126	14.51136	0.04961	12.21535	0.00319	24.47590	0.49142	56.63080
15G1-029	76.22735	5.84677	89.91491	14.92846	470.33827	313.93710	0.01189	7.71911	0.09259	17.47700	0.05648	15.67995	0.00323	21.96710	0.41518	83.79308
15G1-028	76.28329	6.00629	80.61456	10.88978	210.93523	250.63892	0.01190	7.92404	0.08263	14.12741	0.05037	11.69587	0.00328	22.72844	0.52213	63.83568
15G1-093	76.33890	5.92842	86.28239	13.31111	370.93704	291.34249	0.01191	7.81559	0.08869	16.19807	0.05402	14.18781	0.00297	24.73978	0.42415	79.41998
15G1-022	76.36497	5.71618	81.91633	10.33688	246.95383	232.13684	0.01192	7.53311	0.08402	13.20176	0.05116	10.84153	0.00344	23.22529	0.53808	69.07723
15G1-036	76.43595	5.29139	73.36121	7.98615	-25.73365	203.31644	0.01193	6.96662	0.07492	11.32856	0.04558	8.93321	0.00330	21.74262	0.58937	397.02721
15G1-025	76.44165	5.75502	75.51728	8.68426	46.35614	208.07032	0.01193	7.57675	0.07721	11.98381	0.04696	9.28464	0.00332	22.49271	0.58793	-64.90082
15G1-032	76.45761	5.73539	74.59656	7.99521	15.35622	186.55552	0.01193	7.54933	0.07623	11.16034	0.04636	8.21954	0.00338	22.44672	0.65224	-397.89356
15G1-008	76.64439	5.60925	82.04789	8.32400	242.33843	166.90009	0.01196	7.36533	0.08416	10.60412	0.05106	7.62884	0.00311	22.81472	0.66611	68.37300
15G1-048	76.67479	5.73372	84.05759	15.25494	299.20351	356.57962	0.01197	7.52588	0.08631	19.05252	0.05234	17.50313	0.00309	22.12182	0.36924	74.37370
15G1-071	76.69075	5.59191	108.74262	10.10940	883.86455	130.32064	0.01197	7.33815	0.11304	9.85229	0.06854	6.57412	0.00295	22.24304	0.71405	91.32325
15G1-090	76.74361	5.70149	84.64935	10.53758	313.80090	226.41840	0.01198	7.47688	0.08694	13.04216	0.05267	10.68617	0.00795	21.15045	0.54285	75.54385
15G1-033	77.13340	5.83110	82.14067	10.16107	230.29251	225.35017	0.01204	7.60851	0.08426	12.94208	0.05079	10.46938	0.00329	23.13142	0.54176	66.50633
15G1-011	77.13591	5.51733	93.32029	14.21167	529.69953	286.76842	0.01204	7.19870	0.09626	16.05153	0.05802	14.34679	0.00315	23.09039	0.40838	85.43780
15G1-003	77.19346	5.53756	75.17790	8.65235	11.55055	215.51415	0.01205	7.21976	0.07685	11.99150	0.04629	9.57451	0.00295	21.96537	0.56772	-568.30997
15G1-019	77.28597	6.00322	82.40281	11.14715	233.36165	251.88405	0.01206	7.81784	0.08454	14.16156	0.05086	11.80810	0.00311	23.89937	0.50434	66.88146
15G1-023	77.30195	5.61912	76.57389	7.64635	53.90818	167.69638	0.01206	7.31592	0.07833	10.40598	0.04711	7.40011	0.00302	22.57850	0.68027	-43.39558
15G1-066	77.32753	5.77185	86.45289	10.44734	346.36994	215.66455	0.01207	7.51238	0.08887	12.67126	0.05344	10.20416	0.00306	23.21814	0.55142	77.67487
15G1-065	77.40266	6.42978	69.42138	10.51198	-197.64456	304.55233	0.01208	8.36106	0.07076	15.74719	0.04250	13.34416	0.00354	22.96781	0.47751	139.16255
15G1-037	77.41364	5.78684	81.10213	8.68081	191.14514	181.91959	0.01208	7.52357	0.08315	11.18445	0.04994	8.27574	0.00330	21.42799	0.65308	59.50008
15G1-080	77.43355	5.59299	83.21707	8.91549	252.53272	185.19726	0.01208	7.26957	0.08541	11.20768	0.05128	8.53026	0.00355	25.81376	0.62009	69.33722
15G1-092	77.51235	5.55370	76.56667	8.70020	47.14602	210.46518	0.01210	7.21119	0.07832	11.84740	0.04698	9.39998	0.00307	22.72500	0.58258	-64.40913
15G1-096	77.52200	5.49876	79.26830	7.50661	132.22780	153.20838	0.01210	7.13894	0.08120	9.88080	0.04870	6.83124	0.00311	21.48008	0.70631	41.37239
15G1-002	77.53587	6.10940	95.98254	13.30865	582.60795	246.61529	0.01210	7.93069	0.09914	14.62703	0.05945	12.29041	0.00345	24.03128	0.49037	86.69159
15G1-015	77.54252	5.80927	100.60397	11.12866	688.61022	179.72224	0.01210	7.54027	0.10415	11.68280	0.06245	8.92369	0.00423	22.77853	0.62061	88.73927
15G1-067	77.55185	6.02325	78.73315	9.32632	114.73287	211.72952	0.01210	7.81720	0.08063	12.36737	0.04834	9.58349	0.00345	23.14326	0.61190	32.40660
15G1-054	77.72304	6.35991	79.44964	10.42262	131.68673	239.24619	0.01213	8.23627	0.08139	13.70869	0.04869	10.95864	0.00355	22.76366	0.57056	40.97884
15G1-040	77.72606	5.83353	79.98741	8.46905	148.06473	179.07779	0.01213	7.55399	0.08196	11.05654	0.04903	8.07367	0.00322	21.72736	0.66246	47.50535
15G1-085	77.81626	5.86312	74.08648	7.85997	-44.67459	184.47092	0.01214	7.58358	0.07569	11.04363	0.04522	8.02813	0.00312	22.55556	0.66851	274.18460
15G1-088	77.89417	5.61590	75.32484	6.98425	-5.46910	146.88009	0.01216	7.25646	0.07700	9.65352	0.04596	6.36664	0.00318	21.91939	0.73127	1524.25814
15G1-030	77.91040	5.65854	80.63346	8.20443	162.07527	171.07126	0.01216	7.31006	0.08265	10.62720	0.04932	7.71365	0.00319	21.45487	0.67051	51.92950
15G1-070	78.00649	5.77867	79.11838	8.02786	112.82755	168.44091	0.01217	7.45619	0.08104	10.58889	0.04830	7.51864	0.00300	21.99404	0.67995	30.86220
15G1-079	78.04812	6.05198	79.94255	8.93967	136.93235	192.33752	0.01218	7.80486	0.08191	11.67994	0.04879	8.68937	0.00348	21.92339	0.63844	43.00243
15G1-046	78.11234	5.87081	79.40384	9.35447	118.43998	214.07718	0.01219	7.56493	0.08134	12.30410	0.04841	9.70375	0.00299	22.77824	0.59541	34.04900
15G1-075	78.15529	6.12613	91.46781	13.01021	454.31825	259.96718	0.01220	7.88977	0.09426	14.96978	0.05607	12.72186	0.00331	23.33040	0.49633	82.79724
15G1-006	78.26195	5.52313	83.25220	8.77269	228.86810	183.88018	0.01221	7.10320	0.08545	11.02293	0.05076	8.42908	0.00274	21.44479	0.61755	65.80478
15G1-021	78.32114	5.66204	84.91716	9.52090	274.58443	198.43975	0.01222	7.27646	0.08723	11.74231	0.05178	9.21603	0.00346	22.43175	0.58556	71.47648
15G1-072	78.32632	5.71310	99.03192	12.96392	631.47502	234.10301	0.01222	7.34163	0.10245	13.82749	0.06081	11.71750	0.00479	21.30202	0.49441	87.59629
15G1-053	78.42396	6.53292	82.70246	12.15619	208.08410	274.76575	0.01224	8.38528	0.08486	15.39742	0.05031	12.91385	0.00351	24.54073	0.49418	62.31141
15G1-031	78.45674	5.84790	78.19566	7.98264	70.22469	170.55727	0.01224	7.50251	0.08005	10.64848	0.04744	7.55662	0.00296	21.97919	0.68367	-11.72245
15G1-073	78.59877	5.80594	79.24140	8.19534	98.66140	175.40640	0.01227	7.43528	0.08117	10.79456	0.04801	7.82554	0.00301	21.41628	0.66878	20.33483
15G1-009	78.67019	5.85906	82.45032	8.84965	193.37868	183.45673	0.01228	7.49656	0.08459	11.22382	0.04999	8.35319	0.00303	22.51232	0.64242	59.31807
15G1-074	78.71816	5.79740	75.22933	7.54071	-34.26972	169.30716	0.01229	7.41315	0.07690	10.43825	0.04542	7.34862	0.00318	22.22562	0.68752	329.70181
15G1-039	78.78252	5.84261	80.11386	10.02040	119.99847	235.10403	0.01230	7.46492	0.08210	13.07201	0.04844	10.73091	0.00316	22.13560	0.53688	34.34706
15G1-050	78.80682	6.26101	81.38521	11.33817	157.73613	262.82508	0.01230	7.99730	0.08345	14.57851	0.04923	12.18919	0.00368	23.12062	0.48529	50.03883
15G1-044	78.83068	5.80394	78.63491	8.21912	72.68993	179.98398	0.01230	7.41098	0.08052	10.90629	0.04749	8.00153	0.00581	21.17858	0.64826	-8.44788
15G1-007	79.05186	5.76985	79.54004	8.33189	94.22884	181.37034	0.01234	7.34695	0.08148	10.93553	0.04792	8.09988	0.00311	23.09529	0.64631	16.10651
15G1-091	79.09084	5.59588	76.93714	7.77837	10.53737	176.98485	0.01234	7.12184	0.07872	10.53821	0.04627	7.76745	0.00317	22.06783	0.65116	-650.57443
15G1-078	79.18216	5.78087	73.88380	7.32448	-94.37700	168.79132	0.01236	7.34895	0.07548	10.31573	0.04431	7.23928	0.00341	22.44390	0.69133	183.89985
15G1-020	79.37493	6.22814	88.74133	13.93362	348.58076	298.27334	0.01239	7.89870	0.09133	16.51053	0.05349	14.49856	0.00303	24.42045	0.42453	77.22911
15G1-024	79.40689	6.28213	86.61589	10.37072	290.14969	207.77613	0.01239	7.96402	0.08905	12.55518	0.05213	9.70603	0.00354	24.20544	0.60318	72.63244
15G1-016	79.47056	5.72914	99.82733	21.02201	618.11990	400.50366	0.01240	7.25689	0.10331	22.34097	0.06043	21.12952	0.00357	22.24001	0.29891	87.14318
15G1-042	79.50580	6.06399	79.71093	9.46116	85.86354	215.99367	0.01241	7.67785	0.08167	12.39900	0.04775	9.73580	0.00346	23.21838	0.58363	7.40447
15G1-055	79.51971	6.33134	90.43143	12.14845	388.85684	241.89465	0.01241	8.01512	0.09315	14.12531	0.05445	11.63109	0.00327	24.52163	0.52331	79.55039

Table 4 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15G001: Murdunu-Goynuk volcanic

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15G001																
15G1-069	71.64040	5.55840	70.65731	6.07350	37.50734	100.45457	0.01118	7.80530	0.07207	8.92492	0.04679	4.32798	0.00321	21.25453	0.87140	-91.00370
15G1-056	73.23392	5.71751	77.85820	11.12078	222.20420	269.60925	0.01143	7.85511	0.07970	14.91954	0.05061	12.68424	0.00340	24.35878	0.48073	67.04206
15G1-049	74.03874	5.52419	82.10409	10.42430	323.55643	231.43697	0.01155	7.50735	0.08422	13.28475	0.05290	10.96012	0.00345	22.59370	0.53514	77.11721
15G1-062	74.31274	6.17132	94.25040	15.39691	633.70196	295.11154	0.01159	8.35648	0.09727	17.23644	0.06087	15.07528	0.00460	28.41613	0.41016	88.27324
15G1-035	74.78218	5.39256	75.97376	7.17021	113.62420	149.42975	0.01167	7.25596	0.07769	9.82990	0.04831	6.63159	0.00318	21.58237	0.72177	34.18464
15G1-058	75.12693	5.60480	76.99781	8.18363	135.46019	181.09795	0.01172	7.50726	0.07878	11.08106	0.04876	8.15052	0.00401	20.97780	0.65913	44.53947
15G1-063	75.13139	5.80940	88.45248	12.57585	464.66516	260.08704	0.01172	7.78098	0.09102	14.93821	0.05634	12.75172	0.00362	23.92104	0.46365	83.83107
15G1-027	75.31949	5.44927	78.85881	7.03847	187.46258	129.70870	0.01175	7.28029	0.08076	9.30871	0.04986	5.80082	0.00318	21.22155	0.76901	59.82159
15G1-089	75.33653	5.73397	82.03158	9.62458	281.61845	205.69590	0.01176	7.65911	0.08414	12.27116	0.05194	9.58746	0.00331	23.12278	0.59684	73.24872
15G1-034	75.41464	5.64023	112.10771	10.57073	984.47426	128.87273	0.01177	7.52608	0.11674	10.01121	0.07198	6.60170	0.00435	20.93165	0.72177	92.33960
15G1-026	75.46599	5.86489	80.58209	11.11526	235.02352	258.02476	0.01178	7.82070	0.08260	14.42711	0.05089	12.12346	0.00296	22.79308	0.49605	67.89003
15G1-082	75.53198	5.71282	73.50529	7.50086	8.07197	169.16545	0.01179	7.61122	0.07508	10.61750	0.04622	7.40274	0.00401	20.61442	0.70425	-835.73178
15G1-059	75.64037	6.07951	81.84022	9.47954	266.77219	194.64784	0.01180	8.08845	0.08394	12.11250	0.05160	9.01607	0.00312	22.06847	0.64452	71.64608
15G1-083	75.65434	5.65318	76.04306	8.74566	88.27841	207.59736	0.01181	7.51961	0.07777	11.98852	0.04780	9.33702	0.00326	22.36142	0.59532	14.30029
15G1-061	75.66797	5.80539	79.07145	11.04019	183.16852	265.48160	0.01181	7.72079	0.08099	14.59218	0.04977	12.38229	0.00320	24.82363	0.48274	58.68943
15G1-012	76.03287	5.47556	78.44885	7.85077	152.67319	167.14156	0.01186	7.24720	0.08032	10.43937	0.04912	7.51390	0.00333	22.35132	0.67320	50.19894
15G1-095	76.04787	5.70004	88.38770	12.26554	435.87839	256.07404	0.01187	7.54297	0.09095	14.57760	0.05561	12.47437	0.00314	22.66703	0.48572	82.55296
15G1-060	76.17139	5.92910	79.33342	11.01416	175.63478	262.52265	0.01189	7.83358	0.08126	14.51136	0.04961	12.21535	0.00319	24.47590	0.49142	56.63080
15G1-029	76.22735	5.84677	89.91491	14.92846	470.33827	313.93710	0.01189	7.71911	0.09259	17.47700	0.05648	15.67995	0.00323	21.96710	0.41518	83.79308
15G1-028	76.28329	6.00629	80.61456	10.88978	210.93523	250.63892	0.01190	7.92404	0.08263	14.12741	0.05037	11.69587	0.00328	22.72844	0.52213	63.83568
15G1-093	76.33890	5.92842	86.28239	13.31111	370.93704	291.34249	0.01191	7.81559	0.08869	16.19807	0.05402	14.18781	0.00297	24.73978	0.42415	79.41998
15G1-022	76.36497	5.71618	81.91633	10.33688	246.95383	232.13684	0.01192	7.53311	0.08402	13.20176	0.05116	10.84153	0.00344	23.22529	0.53808	69.07723
15G1-036	76.43595	5.29139	73.36121	7.98615	-25.73365	203.31644	0.01193	6.96662	0.07492	11.32856	0.04558	8.93321	0.00330	21.74262	0.58937	397.02721
15G1-025	76.44165	5.75502	75.51728	8.68426	46.35614	208.07032	0.01193	7.57675	0.07721	11.98381	0.04696	9.28464	0.00332	22.49271	0.58793	-64.90082
15G1-032	76.45761	5.73539	74.59656	7.99521	15.35622	186.55552	0.01193	7.54933	0.07623	11.16034	0.04636	8.21954	0.00338	22.44672	0.65224	-397.89356
15G1-008	76.64439	5.60925	82.04789	8.32400	242.33843	166.90009	0.01196	7.36533	0.08416	10.60412	0.05106	7.62884	0.00311	22.81472	0.66611	68.37300
15G1-048	76.67479	5.73372	84.05759	15.25494	299.20351	356.57962	0.01197	7.52588	0.08631	19.05252	0.05234	17.50313	0.00309	22.12182	0.36924	74.37370
15G1-071	76.69075	5.59191	108.74262	10.10940	883.86455	130.32064	0.01197	7.33815	0.11304	9.85229	0.06854	6.57412	0.00295	22.24304	0.71405	91.32325
15G1-090	76.74361	5.70149	84.64935	10.53758	313.80090	226.41840	0.01198	7.47688	0.08694	13.04216	0.05267	10.68617	0.00795	21.15045	0.54285	75.54385
15G1-033	77.13340	5.83110	82.14067	10.16107	230.29251	225.35017	0.01204	7.60851	0.08426	12.94208	0.05079	10.46938	0.00329	23.13142	0.54176	66.50633
15G1-011	77.13591	5.51733	93.32029	14.21167	529.69953	286.76842	0.01204	7.19870	0.09626	16.05153	0.05802	14.34679	0.00315	23.09039	0.40838	85.43780
15G1-003	77.19346	5.53756	75.17790	8.65235	11.55055	215.51415	0.01205	7.21976	0.07685	11.99150	0.04629	9.57451	0.00295	21.96537	0.56772	-568.30997
15G1-019	77.28597	6.00322	82.40281	11.14715	233.36165	251.88405	0.01206	7.81784	0.08454	14.16156	0.05086	11.80810	0.00311	23.89937	0.50434	66.88146
15G1-023	77.30195	5.61912	76.57389	7.64635	53.90818	167.69638	0.01206	7.31592	0.07833	10.40598	0.04711	7.40011	0.00302	22.57850	0.68027	-43.39558
15G1-066	77.32753	5.77185	86.45289	10.44734	346.36994	215.66455	0.01207	7.51238	0.08887	12.67126	0.05344	10.20416	0.00306	23.21814	0.55142	77.67487
15G1-065	77.40266	6.42978	69.42138	10.51198	-197.64456	304.55233	0.01208	8.36106	0.07076	15.74719	0.04250	13.34416	0.00354	22.96781	0.47751	139.16255
15G1-037	77.41364	5.78684	81.10213	8.68081	191.14514	181.91959	0.01208	7.52357	0.08315	11.18445	0.04994	8.27574	0.00330	21.42799	0.65308	59.50008
15G1-080	77.43355	5.59299	83.21707	8.91549	252.53272	185.19726	0.01208	7.26957	0.08541	11.20768	0.05128	8.53026	0.00355	25.81376	0.62009	69.33722
15G1-092	77.51235	5.55370	76.56667	8.70020	47.14602	210.46518	0.01210	7.21119	0.07832	11.84740	0.04698	9.39998	0.00307	22.72500	0.58258	-64.40913
15G1-096	77.52200	5.49876	79.26830	7.50661	132.22780	153.20838	0.01210	7.13894	0.08120	9.88080	0.04870	6.83124	0.00311	21.48008	0.70631	41.37239
15G1-002	77.53587	6.10940	95.98254	13.30865	582.60795	246.61529	0.01210	7.93069	0.09914	14.62703	0.05945	12.29041	0.00345	24.03128	0.49037	86.69159
15G1-015	77.54252	5.80927	100.60397	11.12866	688.61022	179.72224	0.01210	7.54027	0.10415	11.68280	0.06245	8.92369	0.00423	22.77853	0.62061	88.73927
15G1-067	77.55185	6.02325	78.73315	9.32632	114.73287	211.72952	0.01210	7.81720	0.08063	12.36737	0.04834	9.58349	0.00345	23.14326	0.61190	32.40660
15G1-054	77.72304	6.35991	79.44964	10.42262	131.68673	239.24619	0.01213	8.23627	0.08139	13.70869	0.04869	10.95864	0.00355	22.76366	0.57056	40.97884
15G1-040	77.72606	5.83353	79.98741	8.46905	148.06473	179.07779	0.01213	7.55399	0.08196	11.05654	0.04903	8.07367	0.00322	21.72736	0.66246	47.50535
15G1-085	77.81626	5.86312	74.08648	7.85997	-44.67459	184.47092	0.01214	7.58358	0.07569	11.04363	0.04522	8.02813	0.00312	22.55556	0.66851	274.18460
15G1-088	77.89417	5.61590	75.32484	6.98425	-5.46910	146.88009	0.01216	7.25646	0.07700	9.65352	0.04596	6.36664	0.00318	21.91939	0.73127	1524.25814
15G1-030	77.91040	5.65854	80.63346	8.20443	162.07527	171.07126	0.01216	7.31006	0.08265	10.62720	0.04932	7.71365	0.00319	21.45487	0.67051	51.92950
15G1-070	78.00649	5.77867	79.11838	8.02786	112.82755	168.44091	0.01217	7.45619	0.08104	10.58889	0.04830	7.51864	0.00300	21.99404	0.67995	30.86220
15G1-079	78.04812	6.05198	79.94255	8.93967	136.93235	192.33752	0.01218	7.80486	0.08191	11.67994	0.04879	8.68937	0.00348	21.92339	0.63844	43.00243
15G1-046	78.11234	5.87081	79.40384	9.35447	118.43998	214.07718	0.01219	7.56493	0.08134	12.30410	0.04841	9.70375	0.00299	22.77824	0.59541	34.04900
15G1-075	78.15529	6.12613	91.46781	13.01021	454.31825	259.96718	0.01220	7.88977	0.09426	14.96978	0.05607	12.72186	0.00331	23.33040	0.49633	82.79724
15G1-006	78.26195	5.52313	83.25220	8.77269	228.86810	183.88018	0.01221	7.10320	0.08545	11.02293	0.05076	8.42908	0.00274	21.44479	0.61755	65.80478
15G1-021	78.32114	5.66204	84.91716	9.52090	274.58443	198.43975	0.01222	7.27646	0.08723	11.74231	0.05178	9.21603	0.00346	22.43175	0.58556	71.47648
15G1-072	78.32632	5.71310	99.03192	12.96392	631.47502	234.10301	0.01222	7.34163	0.10245	13.82749	0.06081	11.71750	0.00479	21.30202	0.49441	87.59629
15G1-053	78.42396	6.53292	82.70246	12.15619	208.08410	274.76575	0.01224	8.38528	0.08486	15.39742	0.05031	12.91385	0.00351	24.54073	0.49418	62.31141
15G1-031	78.45674	5.84790	78.19566	7.98264	70.22469	170.55727	0.01224	7.50251	0.08005	10.64848	0.04744	7.55662	0.00296	21.97919	0.68367	-11.72245
15G1-073	78.59877	5.80594	79.24140	8.19534	98.66140	175.40640	0.01227	7.43528	0.08117	10.79456	0.04801	7.82554	0.00301	21.41628	0.66878	20.33483
15G1-009	78.67019	5.85906	82.45032	8.84965	193.37868	183.45673	0.01228	7.49656	0.08459	11.22382	0.04999	8.35319	0.00303	22.51232	0.64242	59.31807
15G1-074	78.71816	5.79740	75.22933	7.54071	-34.26972	169.30716	0.01229	7.41315	0.07690	10.43825	0.04542	7.34862	0.00318	22.22562	0.68752	329.70181
15G1-039	78.78252	5.84261	80.11386	10.02040	119.99847	235.10403	0.01230	7.46492	0.08210	13.07201	0.04844	10.73091	0.00316	22.13560	0.53688	34.34706
15G1-050	78.80682	6.26101	81.38521	11.33817	157.73613	262.82508	0.01230	7.99730	0.08345	14.57851	0.04923	12.18919	0.00368	23.12062	0.48529	50.03883
15G1-044	78.83068	5.80394	78.63491	8.21912	72.68993	179.98398	0.01230	7.41098	0.08052	10.90629	0.04749	8.00153	0.00581	21.17858	0.64826	-8.44788
15G1-007	79.05186	5.76985	79.54004	8.33189	94.22884	181.37034	0.01234	7.34695	0.08148	10.93553	0.04792	8.09988	0.00311	23.09529	0.64631	16.10651
15G1-091	79.09084	5.59588	76.93714	7.77837	10.53737	176.98485	0.01234	7.12184	0.07872	10.53821	0.04627	7.76745	0.00317	22.06783	0.65116	-650.57443
15G1-078	79.18216	5.78087	73.88380	7.32448	-94.37700	168.79132	0.01236	7.34895	0.07548	10.31573	0.04431	7.23928	0.00341	22.44390	0.69133	183.89985
15G1-020	79.37493	6.22814	88.74133	13.93362	348.58076	298.27334	0.01239	7.89870	0.09133	16.51053	0.05349	14.49856	0.00303	24.42045	0.42453	77.22911
15G1-024	79.40689	6.28213	86.61589	10.37072	290.14969	207.77613	0.01239	7.96402	0.08905	12.55518	0.05213	9.70603	0.00354	24.20544	0.60318	72.63244
15G1-016	79.47056	5.72914	99.82733	21.02201	618.11990	400.50366	0.01240	7.25689	0.10331	22.34097	0.06043	21.12952	0.00357	22.24001	0.29891	87.14318
15G1-042	79.50580	6.06399	79.71093	9.46116	85.86354	215.99367	0.01241	7.67785	0.08167	12.39900	0.04775	9.73580	0.00346	23.21838	0.58363	7.40447
15G1-055	79.51971	6.33134	90.43143	12.14845	388.85684	241.89465	0.01241	8.01512	0.09315	14.12531	0.05445	11.63109	0.00327	24.52163	0.52331	79.55039

Table 4 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15G001: Murdunu-Goynuk volcanic

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15G1-087	79.52345	5.78242	80.16754	9.49130	99.40447	220.37413	0.01241	7.31956	0.08215	12.37059	0.04802	9.97273	0.00320	21.50223	0.56471	20.00013
15G1-076	79.57956	5.97738	79.63363	8.51594	81.25616	184.25230	0.01242	7.56116	0.08158	11.16548	0.04766	8.21565	0.00343	21.86297	0.65316	2.06335
15G1-001	79.63986	6.36270	89.93873	10.93613	372.60547	209.20275	0.01243	8.04276	0.09262	12.77468	0.05406	9.92504	0.00314	24.34348	0.58541	78.62622
15G1-064	79.79204	6.08791	77.44595	8.80672	5.63723	204.41417	0.01245	7.68066	0.07926	11.86198	0.04617	9.03958	0.00308	21.84966	0.62309	-1315.44788
15G1-004	80.03345	6.18927	90.89303	15.13292	386.25778	318.89554	0.01249	7.78520	0.09364	17.53580	0.05439	15.71289	0.00293	23.37930	0.39244	79.27978
15G1-051	80.06139	6.14432	92.28427	12.56932	421.04224	249.14138	0.01250	7.72595	0.09514	14.33709	0.05524	12.07733	0.00356	24.09570	0.48657	80.98495
15G1-047	80.18322	6.33836	89.18548	12.17327	337.30962	249.87316	0.01252	7.95802	0.09181	14.34340	0.05322	11.93328	0.00361	22.32187	0.53022	76.22860
15G1-010	80.30610	5.74012	75.68064	7.60871	-68.07698	176.08997	0.01254	7.19561	0.07738	10.47222	0.04479	7.60858	0.00295	21.67450	0.65970	217.96367
15G1-041	80.37090	5.87793	79.90265	9.01752	65.92391	205.67897	0.01255	7.36255	0.08187	11.78776	0.04735	9.20566	0.00336	21.27279	0.59409	-21.91464
15G1-038	80.38539	5.98182	82.59347	9.47890	146.92344	206.35531	0.01255	7.49140	0.08474	12.00561	0.04900	9.38156	0.00340	21.91004	0.60167	45.28757
15G1-014	80.52716	5.91010	91.50079	11.86042	388.00872	238.60157	0.01257	7.38859	0.09430	13.63438	0.05443	11.45884	0.00323	22.53022	0.51019	79.24604
15G1-017	80.94231	6.04121	82.54154	10.13309	129.06608	228.36679	0.01264	7.51407	0.08469	12.84608	0.04863	10.41924	0.00371	24.32319	0.54286	37.28615
15G1-005	81.13847	5.98915	83.94163	10.27246	164.43709	227.37396	0.01267	7.43139	0.08618	12.81515	0.04937	10.44043	0.00343	23.01618	0.53113	50.65683
15G1-052	81.79821	6.39797	97.62987	10.35735	503.90502	165.81319	0.01277	7.87529	0.10093	11.18393	0.05735	7.94103	0.00358	22.71574	0.67772	83.76714
15G1-077	81.83633	6.39316	97.16092	11.02574	491.74833	187.34690	0.01278	7.86573	0.10042	11.96435	0.05703	9.01532	0.00395	24.23558	0.61221	83.35809
15G1-043	81.89767	6.21181	135.31263	20.88586	1218.12234	266.37804	0.01279	7.63681	0.14255	16.65730	0.08090	14.80354	0.00445	23.70603	0.42239	93.27673
15G1-068	82.38482	5.83495	89.05645	7.88854	271.74795	130.96538	0.01286	7.13114	0.09167	9.28807	0.05171	5.95106	0.00375	21.67740	0.75608	69.68337
15G1-045	82.87033	6.31823	83.49635	8.60726	101.43898	169.94964	0.01294	7.67711	0.08571	10.78383	0.04807	7.57318	0.00359	21.54508	0.69433	18.30525
15G1-081	82.87416	5.94895	90.91365	9.13662	307.40967	166.28174	0.01294	7.22787	0.09367	10.55381	0.05253	7.69031	0.00352	22.18197	0.66299	73.04114
15G1-013	83.75730	6.33135	112.63853	14.02801	776.39418	212.90585	0.01308	7.61212	0.11732	13.24886	0.06509	10.84380	0.00382	22.10138	0.54674	89.21201

a Isotopic dates calculated using λ238 = 1.55125E-10 (Jaffey et al. 1971) and λ235 = 9.8485E-10 (Jaffey et al. 1971).

b % discordance = 100 - (100 * (206Pb/238U date) / (207Pb/206Pb date))

c Measured ratios corrected for fractionation, tracer, blank and initial common Pb.

Table 5: LA-ICP-MS Zircon Isotopic and Age Data Table (IGOR PRO): 15YP12 & 15YP13: SGTFW;SGTHW Basement;Volcanoclastic

	Dates (Ma)						Isotopic Ratios							
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	Rho (ρ)	% disc b
15YP12														
15YP12-004.FIN2	312.7	4	315.1	6.6	313	43	0.04970	1.30785	0.36430	2.44304	0.05280	3.03030	0.09531	0.09585
15YP12-036.FIN2	313	5.2	314.8	8.7	346	37	0.04976	1.68810	0.36500	3.28767	0.05280	3.59848	0.22171	9.53757
15YP12-017.FIN2	313.4	4.2	318.1	7.1	357	29	0.04982	1.38499	0.36860	2.60445	0.05320	2.63158	0.35239	12.21289
15YP12-070.FIN2	314.1	6.6	311.3	8.3	300	40	0.04990	2.20441	0.35900	3.06407	0.05240	2.86260	0.37943	-4.70000
15YP12-007.FIN2	314.9	4.8	313.4	9.2	296	42	0.05007	1.55782	0.36200	3.31492	0.05200	3.84615	-0.04820	-6.38514
15YP12-064.FIN2	315	11	364	11	719	60	0.05000	3.80000	0.43000	3.72093	0.06340	3.47003	0.64211	56.18915
15YP12-058.FIN2	316.8	6.4	321.3	8.3	388	28	0.05040	1.98413	0.37100	2.96496	0.05370	2.79330	0.51548	18.35052
15YP12-018.FIN2	317.1	7.2	312	15	380	66	0.05040	2.38095	0.35700	5.32213	0.05250	5.14286	0.25083	16.55263
15YP12-042.FIN2	317.2	4.6	316.4	9.3	337	41	0.05045	1.48662	0.36400	3.57143	0.05270	3.41556	0.33073	5.87537
15YP12-048.FIN2	317.2	4.2	315.5	5.4	326	31	0.05044	1.36796	0.36470	1.97423	0.05270	2.27704	0.21964	2.69939
15YP12-065.FIN2	317.3	8.9	313.2	7.9	343	37	0.05050	2.97030	0.36200	3.03867	0.05290	3.21361	0.50430	7.49271
15YP12-006.FIN2	317.4	3.1	325.1	5.1	359	30	0.05047	0.99069	0.37770	1.80037	0.05410	2.21811	0.24563	11.58774
15YP12-038.FIN2	317.5	4.6	320	5.3	344	27	0.05049	1.48544	0.37090	1.94122	0.05310	2.25989	0.39586	7.70349
15YP12-011.FIN2	319	5.2	323	11	396	53	0.05074	1.65550	0.37300	4.02145	0.05340	4.30712	-0.01013	19.44444
15YP12-023.FIN2	319	3.5	319.4	6.2	351	29	0.05073	1.10388	0.37020	2.29606	0.05280	2.65152	0.22755	9.11681
15YP12-009.FIN2	319.3	4	324.7	7.9	348	44	0.05078	1.29972	0.37800	2.91005	0.05360	3.17164	0.08310	8.24713
15YP12-010.FIN2	319.6	4.2	321.9	8.4	364	42	0.05074	1.37958	0.37200	2.95699	0.05330	3.18949	0.11171	12.19780
15YP12-015.FIN2	319.8	3.8	324.6	5.9	362	33	0.05086	1.21903	0.37620	2.09995	0.05310	2.44821	0.13047	11.65746
15YP12-068.FIN2	320.3	7	320.6	7.3	405	34	0.05100	2.15686	0.36990	2.64936	0.05320	3.00752	0.36629	20.91358
15YP12-014.FIN2	320.8	3.8	322.2	6.4	294	39	0.05103	1.21497	0.37110	2.20965	0.05210	2.68714	0.24030	-9.11565
15YP12-044.FIN2	320.9	4.3	323.9	5.1	342	27	0.05104	1.37147	0.37450	1.92256	0.05350	2.24299	0.30504	6.16959
15YP12-024.FIN2	321.1	4.3	315.7	7	332	41	0.05107	1.39025	0.36410	2.52678	0.05130	3.11891	-0.02880	3.28313
15YP12-069.FIN2	321.2	7.5	317.6	8.6	324	36	0.05110	2.34834	0.36800	3.26087	0.05170	3.67505	0.28455	0.86420
15YP12-003.FIN2	321.3	4.1	328.7	5.5	372	37	0.05111	1.31090	0.38110	2.02047	0.05410	2.21811	0.36882	13.62903
15YP12-053.FIN2	321.7	6.7	318	7	294	28	0.05120	2.14844	0.36850	2.55088	0.05240	2.67176	0.53690	-9.42177
15YP12-025.FIN2	324	4.8	339	7.6	450	37	0.05155	1.53249	0.39700	2.51889	0.05530	2.53165	0.57151	28.00000
15YP12-034.FIN2	324	4.1	326.6	6.3	362	42	0.05154	1.29996	0.38000	2.26316	0.05350	2.80374	0.23538	10.49724
15YP12-062.FIN2	325.3	6.4	339.9	7.6	429	43	0.05180	1.93050	0.39900	2.75689	0.05560	2.51799	0.46031	24.17249
15YP12-021.FIN2	325.8	3.9	327.8	6.2	321	36	0.05184	1.21528	0.38060	2.25959	0.05320	2.63158	0.12066	-1.49533
15YP12-041.FIN2	326.4	5.6	328.5	8	349	40	0.05195	1.75168	0.38000	2.89474	0.05330	2.81426	0.44650	6.47564
15YP12-052.FIN2	327.6	5.1	326.9	6.1	346	35	0.05214	1.61105	0.37930	2.24097	0.05320	2.63158	0.22603	5.31792
15YP12-002.FIN2	328	4.8	326.7	5.9	343	35	0.05220	1.51341	0.38000	2.10526	0.05300	2.83019	0.11175	4.37318
15YP12-055.FIN2	328	5.7	316.1	7.2	292	31	0.05221	1.78127	0.36590	2.65100	0.05140	2.72374	0.37430	-12.32877
15YP12-061.FIN2	328	5.5	329.5	7.4	364	35	0.05220	1.70498	0.38400	2.60417	0.05320	2.44361	0.52026	9.89011
15YP12-047.FIN2	328.8	5.5	329.6	6.9	336	29	0.05233	1.71985	0.38010	2.39411	0.05360	2.42537	0.39477	2.14286
15YP12-040.FIN2	329	5	325.1	6	314	22	0.05237	1.56578	0.37700	2.14854	0.05240	2.29008	0.52882	-4.77707
15YP12-043.FIN2	329.1	4.3	327.2	9.1	335	41	0.05238	1.35548	0.37800	3.17460	0.05320	3.57143	0.20377	1.76119
15YP12-051.FIN2	331	5.5	330.3	9.8	375	43	0.05260	1.71103	0.38600	3.36788	0.05360	3.54478	0.30648	11.73333
15YP12-049.FIN2	331.2	5.3	331	6.4	361	40	0.05272	1.63126	0.38580	2.25505	0.05380	2.78810	0.12537	8.25485
15YP12-022.FIN2	332.8	6.4	325	11	281	38	0.05300	1.88679	0.37800	3.96825	0.05220	4.59770	-0.05052	-18.43416
15YP12-026.FIN2	333.5	5.5	327	9.7	307	40	0.05310	1.67608	0.38100	3.41207	0.05140	3.69650	0.23416	-8.63192
15YP12-037.FIN2	336.9	5.2	351.1	9	470	37	0.05366	1.58405	0.41300	2.90557	0.05650	3.00885	0.37550	28.31915
15YP12-066.FIN2	338	10	346.2	8.9	417	40	0.05380	3.15985	0.40700	2.94840	0.05460	3.29670	0.42688	18.94484
15YP12-016.FIN2	344.6	6.1	354	11	426	49	0.05490	1.82149	0.41600	3.84615	0.05450	3.85321	0.31116	19.10798
15YP12-001.FIN2	345.8	5.4	335.6	9.5	317	46	0.05511	1.61495	0.38900	3.34190	0.05110	3.71820	0.02322	-9.08517
15YP12-031.FIN2	349.2	5.6	345.2	6.7	340	32	0.05568	1.63434	0.40540	2.31870	0.05270	2.27704	0.53887	-2.70588
15YP12-039.FIN2	351	5.4	356.2	6.9	398	30	0.05596	1.59042	0.41980	2.33444	0.05480	2.18978	0.62135	11.80905
15YP12-060.FIN2	352.6	5.4	353.6	9.8	405	37	0.05622	1.58307	0.41800	3.34928	0.05410	3.14233	0.49966	12.93827
15YP12-045.FIN2	353.1	5.3	352.4	7.9	357	32	0.05631	1.56278	0.41100	2.67640	0.05410	2.58780	0.39160	1.09244
15YP12-029.FIN2	353.6	6	339.4	8.1	283	43	0.05639	1.73790	0.39600	2.77778	0.05090	3.14342	0.26390	-24.94700
15YP12-027.FIN2	357.7	5.7	360.4	8.4	376	29	0.05706	1.62986	0.42700	2.81030	0.05360	2.61194	0.47617	4.86702
15YP12-028.FIN2	360.7	7.2	364	11	374	50	0.05760	2.08333	0.43200	3.47222	0.05500	4.00000	0.21815	3.55615
15YP12-008.FIN2	471.4	5.3	471.5	9.8	449	38	0.07587	1.17306	0.59000	2.54237	0.05570	2.69300	0.23221	-4.98886
15YP12-067.FIN2	483	16	502	19	594	52	0.07790	3.59435	0.64100	4.99220	0.05900	4.06780	0.57285	18.68687
15YP12-046.FIN2	570.2	7.5	567.6	7.7	574	24	0.09250	1.40541	0.75000	1.73333	0.05950	2.01681	0.49761	0.66202
15YP12-059.FIN2	602.3	9.9	607	24	684	87	0.09800	1.73469	0.82400	5.21845	0.06130	5.54649	0.08328	11.94444
15YP12-063.FIN2	608	16	617	17	662	27	0.09900	2.72727	0.84000	3.80952	0.06090	3.28407	0.63321	8.15710
15YP12-035.FIN2	839	16	830	16	843	32	0.13880	2.01729	1.27000	2.83465	0.06690	2.84006	0.40613	0.47450
15YP12-013.FIN2	1691	27	1695	21	1673	30	0.29940	1.83701	4.33000	2.54042	0.10250	2.73171	0.38934	-1.07591
15YP12-012.FIN2	2512	28	2606	17	2669	19	0.47660	1.34285	12.04000	1.82724	0.18190	1.92413	0.54821	5.88235
15YP13::15YP13														
15YP13-014.FIN2	66	1	63.9	1.9	152	25	0.01029	1.55491	0.06500	3.07692	0.04670	3.64026	0.04677	56.57895
15YP13-094.FIN2	78.2	1.2	78.9	2.2	179	32	0.01220	1.55738	0.08060	2.97767	0.04810	3.11850	0.21600	56.31285
15YP13-006.FIN2	78.4	1.4	80.4	2.3	200	35	0.01224	1.79739	0.08250	3.03030	0.04870	3.28542	0.22673	60.80000
15YP13-061.FIN2	78.6	1.3	81.7	2.6	149	42	0.01227	1.62999	0.08380	3.34129	0.04820	3.11203	0.33370	47.24832
15YP13-018.FIN2	78.9	1.6	75.6	3.4	278	44	0.01231	2.03087	0.07740	4.65116	0.04610	5.42299	-0.15802	71.61871
15YP13-068.FIN2	79.3	1.7	77.5	1.9	114	27	0.01238	2.10016	0.07940	2.51889	0.04680	2.77778	0.43293	30.43860
15YP13-012.FIN2	79.5	1.1	79.5	1.8	160	29	0.01242	1.36876	0.08150	2.33129	0.04750	2.73684	0.20385	50.31250
15YP13-015.FIN2	79.5	1	80.6	2.1	170	36	0.01241	1.28928	0.08260	2.66344	0.04770	3.14465	0.06538	53.23529
15YP13-025.FIN2	79.8	1.6	81.4	4.3	374	53	0.01246	2.00642	0.08370	5.49582	0.04880	5.73770	0.09223	78.66310

Table 5 cont: LA-ICP-MS Zircon Isotopic and Age Data Table (IGOR PRO): 15YP12 & 15YP13: SGTFW;SGTHW Basement;Volcanoclastic

	Dates (Ma)						Isotopic Ratios							
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	Rho (ρ)	% disc b
15YP12-046.FIN2	570.2	7.5	567.6	7.7	574	24	0.09250	1.40541	0.75000	1.73333	0.05950	2.01681	0.49761	0.66202
15YP12-059.FIN2	602.3	9.9	607	24	684	87	0.09800	1.73469	0.82400	5.21845	0.06130	5.54649	0.08328	11.94444
15YP12-063.FIN2	608	16	617	17	662	27	0.09900	2.72727	0.84000	3.80952	0.06090	3.28407	0.63321	8.15710
15YP12-035.FIN2	839	16	830	16	843	32	0.13880	2.01729	1.27000	2.83465	0.06690	2.84006	0.40613	0.47450
15YP12-013.FIN2	1691	27	1695	21	1673	30	0.29940	1.83701	4.33000	2.54042	0.10250	2.73171	0.38934	-1.07591
15YP12-012.FIN2	2512	28	2606	17	2669	19	0.47660	1.34285	12.04000	1.82724	0.18190	1.92413	0.54821	5.88235
15YP13::15YP13														
15YP13-014.FIN2	66	1	63.9	1.9	152	25	0.01029	1.55491	0.06500	3.07692	0.04670	3.64026	0.04677	56.57895
15YP13-094.FIN2	78.2	1.2	78.9	2.2	179	32	0.01220	1.55738	0.08060	2.97767	0.04810	3.11850	0.21600	56.31285
15YP13-006.FIN2	78.4	1.4	80.4	2.3	200	35	0.01224	1.79739	0.08250	3.03030	0.04870	3.28542	0.22673	60.80000
15YP13-061.FIN2	78.6	1.3	81.7	2.6	149	42	0.01227	1.62999	0.08380	3.34129	0.04820	3.11203	0.33370	47.24832
15YP13-018.FIN2	78.9	1.6	75.6	3.4	278	44	0.01231	2.03087	0.07740	4.65116	0.04610	5.42299	-0.15802	71.61871
15YP13-068.FIN2	79.3	1.7	77.5	1.9	114	27	0.01238	2.10016	0.07940	2.51889	0.04680	2.77778	0.43293	30.43860
15YP13-012.FIN2	79.5	1.1	79.5	1.8	160	29	0.01242	1.36876	0.08150	2.33129	0.04750	2.73684	0.20385	50.31250
15YP13-015.FIN2	79.5	1	80.6	2.1	170	36	0.01241	1.28928	0.08260	2.66344	0.04770	3.14465	0.06538	53.23529
15YP13-025.FIN2	79.8	1.6	81.4	4.3	374	53	0.01246	2.00642	0.08370	5.49582	0.04880	5.73770	0.09223	78.66310
15YP13-027.FIN2	80	1	80.2	2.1	189	37	0.01249	1.28102	0.08220	2.67640	0.04760	3.15126	0.08377	57.67196
15YP13-119.FIN2	80.1	1.2	79.6	6.4	160	160	0.01250	1.60000	0.08160	8.70098	0.04690	8.95522	0.33474	49.93750
15YP13-055.FIN2	80.3	1.5	82.8	2.3	215	33	0.01253	1.91540	0.08470	2.83353	0.04840	2.89256	0.36362	62.65116
15YP13-072.FIN2	80.3	1.8	78.5	2.7	186	30	0.01254	2.23285	0.08040	3.60697	0.04670	3.64026	0.41692	56.82796
15YP13-104.FIN2	80.3	1.4	80.5	4.3	174	88	0.01254	1.75439	0.08260	5.69007	0.04780	5.02092	0.16679	53.85057
15YP13-070.FIN2	80.4	1.6	80.5	2.5	250	43	0.01255	1.99203	0.08250	3.27273	0.04840	3.71901	0.24712	67.84000
15YP13-076.FIN2	80.4	1.3	79.5	2	193	34	0.01256	1.59236	0.08150	2.57669	0.04710	2.97240	0.14851	58.34197
15YP13-121.FIN2	80.4	1.1	80.9	2.1	201	31	0.01255	1.35458	0.08300	2.65060	0.04840	3.09917	0.16721	60.00000
15YP13-004.FIN2	80.5	1.3	79.5	2.2	198	44	0.01257	1.59109	0.08120	2.83251	0.04750	3.36842	0.17071	59.34343
15YP13-002.FIN2	80.6	1.3	81.5	3	241	47	0.01258	1.58983	0.08360	3.82775	0.04830	3.72671	0.43747	66.55602
15YP13-009.FIN2	80.6	1.1	79.7	2.4	153	24	0.01258	1.35135	0.08170	3.05998	0.04700	3.40426	0.18681	47.32026
15YP13-071.FIN2	80.6	1.6	81.6	2.5	178	26	0.01258	2.06677	0.08350	3.11377	0.04860	3.29218	0.30935	54.71910
15YP13-073.FIN2	80.6	1.8	80	2.8	207	36	0.01259	2.30342	0.08210	3.53228	0.04670	3.85439	0.27375	61.06280
15YP13-088.FIN2	80.6	1.3	81.9	2.3	234	40	0.01259	1.58856	0.08400	2.85714	0.04780	3.34728	0.09385	65.55556
15YP13-024.FIN2	80.7	1.3	83.1	2.1	204	36	0.01260	1.66667	0.08530	2.69637	0.04880	2.66393	0.22321	60.44118
15YP13-042.FIN2	80.7	1.3	81.4	2.2	169	31	0.01260	1.58730	0.08360	2.75120	0.04770	3.14465	0.19600	52.24852
15YP13-101.FIN2	80.7	1.2	79.2	3.4	240	47	0.01260	1.50794	0.08080	4.45545	0.04690	4.90405	-0.06647	66.37500
15YP13-085.FIN2	80.8	1.1	80	2	133	26	0.01261	1.42744	0.08200	2.56098	0.04680	2.77778	0.18277	39.24812
15YP13-087.FIN2	80.8	1.5	78.8	2.6	211	34	0.01261	1.82395	0.08070	3.34572	0.04740	3.58650	0.38839	61.70616
15YP13-013.FIN2	80.9	1.1	80	2.1	170	37	0.01262	1.34707	0.08200	2.80488	0.04700	3.19149	0.26552	52.41176
15YP13-005.FIN2	81	1	80.1	2.2	199	34	0.01264	1.26582	0.08190	2.93040	0.04760	3.15126	0.24852	59.29648
15YP13-045.FIN2	81.1	1.3	79.9	2.6	205	48	0.01267	1.65746	0.08150	3.55828	0.04640	3.66379	0.15853	60.43902
15YP13-107.FIN2	81.1	1.2	79.1	2.6	217	41	0.01266	1.50079	0.08110	3.32922	0.04640	4.09483	-0.02103	62.62673
15YP13-020.FIN2	81.2	1.4	80	3.2	238	47	0.01267	1.73639	0.08210	4.14129	0.04740	4.43038	-0.01154	65.88235
15YP13-031.FIN2	81.2	1.2	81.6	2.3	176	35	0.01267	1.49961	0.08370	2.98686	0.04800	3.33333	0.24101	53.86364
15YP13-078.FIN2	81.3	1.4	84.3	2.6	238	37	0.01269	1.65485	0.08640	3.12500	0.04880	3.48361	0.26158	65.84034
15YP13-114.FIN2	81.4	1.2	81	1.7	141	31	0.01271	1.41621	0.08310	2.16606	0.04700	2.55319	0.23671	42.26950
15YP13-022.FIN2	81.5	1.5	78.7	3.2	277	56	0.01273	1.80676	0.08070	4.21314	0.04600	4.56522	-0.01114	70.57762
15YP13-003.FIN2	81.6	1.3	80.1	2.2	151	28	0.01273	1.64965	0.08220	2.79805	0.04710	3.18471	0.22905	45.96026
15YP13-036.FIN2	81.7	1.3	81.6	3.2	288	50	0.01276	1.64577	0.08380	4.05728	0.04710	4.67091	-0.13142	71.63194
15YP13-098.FIN2	81.7	1.1	83.7	2.2	206	30	0.01276	1.33229	0.08600	2.79070	0.04880	2.66393	0.34948	60.33981
15YP13-041.FIN2	81.8	1.2	82.3	2.5	183	29	0.01277	1.48786	0.08450	3.19527	0.04770	3.35430	0.00166	55.30055
15YP13-115.FIN2	81.8	2.2	75.7	6.2	340	100	0.01278	2.66041	0.07770	8.49421	0.04450	8.31461	-0.06071	75.94118
15YP13-091.FIN2	81.9	1.2	79.8	2.1	199	37	0.01279	1.40735	0.08180	2.68949	0.04650	3.44086	0.06479	58.84422
15YP13-034.FIN2	82	1.5	82.9	4	311	47	0.01280	1.87500	0.08530	5.04103	0.04800	5.20833	0.13984	73.63344
15YP13-044.FIN2	82	1.1	83.3	5.8	170	110	0.01280	1.32813	0.08550	7.60234	0.04820	7.46888	0.30652	51.76471

Table 5 cont: LA-ICP-MS Zircon Isotopic and Age Data Table (IGOR PRO): 15YP12 & 15YP13: SGTFW;SGTHW Basement;Volcanoclastic

	Dates (Ma)						Isotopic Ratios							
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	Rho (ρ)	% disc b
15YP13-056.FIN2	82	1.3	79.1	2.2	189	36	0.01280	1.64063	0.08110	2.95931	0.04610	3.47072	0.12375	56.61376
15YP13-067.FIN2	82	2	81.7	2.7	212	41	0.01280	2.50000	0.08380	3.46062	0.04740	3.58650	0.34661	61.32075
15YP13-079.FIN2	82	1.2	80.5	2	167	29	0.01280	1.48438	0.08260	2.66344	0.04730	2.95983	0.28642	50.89820
15YP13-116.FIN2	82	1.4	79.6	4.4	399	59	0.01280	1.71875	0.08120	5.66502	0.04870	5.95483	0.04007	79.44862
15YP13-060.FIN2	82.1	1.2	83.4	2.7	153	53	0.01282	1.40406	0.08530	3.51700	0.04770	3.35430	0.31063	46.33987
15YP13-075.FIN2	82.1	1.7	83.5	2.4	182	37	0.01282	2.02808	0.08580	3.03030	0.04760	2.94118	0.45718	54.89011
15YP13-097.FIN2	82.2	1.3	81.1	3.6	258	41	0.01283	1.63679	0.08330	4.56182	0.04710	4.88323	-0.02336	68.13953
15YP13-021.FIN2	82.3	1.5	86.7	2.6	242	36	0.01285	1.86770	0.08920	3.13901	0.04970	3.21932	0.12101	65.99174
15YP13-063.FIN2	82.3	1.5	82.3	2	145	28	0.01285	1.86770	0.08440	2.48815	0.04740	2.53165	0.54498	43.24138
15YP13-089.FIN2	82.3	1.1	80.4	2.3	169	28	0.01285	1.40078	0.08250	3.03030	0.04680	3.20513	0.19726	51.30178
15YP13-062.FIN2	82.4	1.1	82.3	2.4	181	32	0.01287	1.39860	0.08450	2.95858	0.04740	3.16456	0.20644	54.47514
15YP13-026.FIN2	82.5	1.5	87.1	4.4	259	80	0.01288	1.86335	0.08960	5.35714	0.05000	5.00000	0.05270	68.14672
15YP13-040.FIN2	82.5	1.2	85.5	2.8	233	35	0.01289	1.47401	0.08800	3.40909	0.04930	3.65112	-0.01402	64.59227
15YP13-049.FIN2	82.5	4.4	76	47	190	310	0.01288	5.35714	0.07800	87.17949	0.04400	59.09091	-0.15501	56.57895
15YP13-100.FIN2	82.5	1.3	82.8	2.4	193	34	0.01289	1.55159	0.08440	2.96209	0.04830	3.10559	0.31497	57.25389
15YP13-117.FIN2	82.5	1.2	80.8	2.1	183	37	0.01288	1.47516	0.08280	2.77778	0.04690	2.98507	0.31887	54.91803
15YP13-037.FIN2	82.6	1.4	80.2	2.9	228	39	0.01290	1.78295	0.08220	3.77129	0.04630	4.10367	0.22025	63.77193
15YP13-084.FIN2	82.8	1.4	86.9	2.7	304	39	0.01293	1.77881	0.08950	3.24022	0.05030	3.57853	0.18384	72.76316
15YP13-095.FIN2	82.8	2	81.5	6.8	422	81	0.01293	2.39753	0.08420	8.66983	0.04830	9.52381	0.12752	80.37915
15YP13-016.FIN2	83	1.2	82.3	2.8	260	49	0.01296	1.46605	0.08460	3.54610	0.04700	3.61702	0.19774	68.07692
15YP13-057.FIN2	83.1	1.3	83.6	2.3	177	33	0.01297	1.61912	0.08590	2.91036	0.04760	2.73109	0.31451	53.05085
15YP13-077.FIN2	83.1	1.2	81.4	2.4	212	39	0.01297	1.46492	0.08350	3.11377	0.04650	3.22581	0.26924	60.80189
15YP13-054.FIN2	83.2	1.5	83.3	1.9	154	28	0.01298	1.77196	0.08550	2.45614	0.04770	2.93501	0.31485	45.97403
15YP13-035.FIN2	83.4	2.3	91	7.2	620	96	0.01302	2.84178	0.09440	8.15678	0.05180	8.88031	0.11131	86.54839
15YP13-093.FIN2	83.4	1.3	85.2	2.5	223	32	0.01303	1.53492	0.08760	3.19635	0.04880	3.27869	0.32323	62.60090
15YP13-030.FIN2	83.5	1.3	86.3	2.3	200	28	0.01304	1.61043	0.08880	2.81532	0.04870	2.87474	0.35328	58.25000
15YP13-059.FIN2	83.8	1.4	84.3	2.5	150	25	0.01309	1.68067	0.08630	3.01275	0.04720	3.17797	0.26400	44.13333
15YP13-050.FIN2	84.1	1.5	84.9	2	182	29	0.01313	1.82788	0.08720	2.52294	0.04790	2.92276	0.24319	53.79121
15YP13-052.FIN2	84.4	1.7	82.8	3.7	208	45	0.01317	1.97418	0.08510	4.70035	0.04680	4.70085	0.29010	59.42308
15YP13-118.FIN2	84.6	1.4	84.2	2.5	193	33	0.01321	1.74111	0.08630	3.01275	0.04790	3.13152	0.36587	56.16580
15YP13-043.FIN2	84.9	1.3	96	4.4	452	66	0.01326	1.58371	0.09810	4.79103	0.05390	5.00928	-0.05190	81.21681
15YP13-066.FIN2	85	2	87.1	5.3	280	110	0.01327	2.33610	0.08970	6.46600	0.04900	6.53061	0.22627	69.64286
15YP13-123.FIN2	85.2	1.4	85.1	3.2	274	50	0.01330	1.72932	0.08760	3.88128	0.04730	4.01691	0.18247	68.90511
15YP13-103.FIN2	85.4	1.2	85.7	2	182	31	0.01333	1.35034	0.08810	2.49716	0.04750	2.94737	0.15486	53.07692
15YP13-127.FIN2	85.4	1.4	112.3	9.4	720	140	0.01334	1.57421	0.11800	9.32203	0.06330	8.05687	0.60310	88.13889
15YP13-086.FIN2	85.7	2.3	94	17	350	210	0.01339	2.76326	0.09800	20.40816	0.05210	16.89060	0.34027	75.51429
15YP13-053.FIN2	86.6	1.8	89.7	3	270	41	0.01353	2.06948	0.09240	3.46320	0.04950	3.43434	0.30007	67.92593
15YP13-069.FIN2	86.7	2.4	90.2	3.9	283	43	0.01354	2.80650	0.09300	4.51613	0.04950	3.83838	0.18972	69.36396
15YP13-019.FIN2	87.1	1.3	87	3	215	28	0.01361	1.46951	0.08870	3.49493	0.04810	3.74220	0.18683	59.48837

Table 5 cont: LA-ICP-MS Zircon Isotopic and Age Data Table (IGOR PRO): 15YP12 & 15YP13: SGTFW;SGTHW Basement;Volcanoclastic

	Dates (Ma)						Isotopic Ratios							
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	Rho (ρ)	% disc b
15YP13-110.FIN2	88	1.7	87.8	2.3	180	26	0.01375	1.89091	0.09030	2.76855	0.04820	2.69710	0.45762	51.11111
15YP13-124.FIN2	89.1	1.6	110.5	3.7	592	62	0.01392	1.79598	0.11510	3.56212	0.06030	3.64842	0.17608	84.94932
15YP13-001.FIN2	89.2	1.7	101.2	7	326	98	0.01394	1.93687	0.10520	7.60456	0.05480	8.39416	0.36844	72.63804
15YP13-081.FIN2	89.3	1.7	90.4	2.2	164	31	0.01395	1.93548	0.09310	2.57787	0.04770	2.72537	0.40129	45.54878
15YP13-120.FIN2	90	1.4	87.9	2.4	130	32	0.01405	1.56584	0.09050	2.76243	0.04690	2.98507	0.27420	30.76923
15YP13-064.FIN2	92	1.7	222	18	1820	160	0.01437	1.87891	0.24900	8.83534	0.12200	8.19672	0.44020	94.94505
15YP13-058.FIN2	92.4	1.6	107.4	3.6	419	70	0.01441	1.80430	0.11170	3.49150	0.05540	4.15162	0.22777	77.94749
15YP13-065.FIN2	100.4	2.8	111.4	7.4	592	64	0.01570	2.80255	0.11680	7.02055	0.05220	7.27969	0.15320	83.04054
15YP13-082.FIN2	101.9	2.5	102.6	3	252	44	0.01593	2.44821	0.10640	3.00752	0.04720	3.17797	0.14040	59.56349
15YP13-046.FIN2	105.3	4.2	102	13	670	120	0.01647	4.00729	0.10800	12.96296	0.04700	12.76596	0.12761	84.28358
15YP13-047.FIN2	107.8	2.9	107.1	7.2	468	79	0.01687	2.72673	0.11010	7.17530	0.04690	6.82303	0.17178	76.96581
15YP13-074.FIN2	112.5	3	112.4	6.5	437	69	0.01760	2.67045	0.11590	6.38481	0.04700	6.38298	0.23917	74.25629
15YP13-028.FIN2	114.3	2.6	116.9	6	413	72	0.01790	2.29050	0.12160	5.59211	0.04960	6.25000	-0.00364	72.32446
15YP13-090.FIN2	166.6	3.9	175	9.7	444	77	0.02618	2.36822	0.18900	5.82011	0.05280	6.43939	-0.11064	62.47748
15YP13-125.FIN2	172.9	3.3	175.4	7.5	332	47	0.02718	1.94996	0.18930	4.64871	0.05060	4.74308	0.19235	47.92169
15YP13-126.FIN2	211.3	4.4	213.9	8.2	401	50	0.03333	2.13021	0.23500	4.25532	0.05070	4.33925	0.32941	47.30673
15YP13-048.FIN2	275.6	3.8	278.9	4.1	300	27	0.04360	1.42202	0.31630	1.70724	0.05250	1.90476	0.43483	8.13333
15YP13-032.FIN2	299	25	453	62	1270	180	0.04760	8.40336	0.64000	18.75000	0.08620	10.09281	0.95146	76.45669
15YP13-038.FIN2	325.3	4.5	321.9	6.5	300	35	0.05176	1.41036	0.37370	2.32807	0.05180	2.70270	-0.00560	-8.43333
15YP13-007.FIN2	327.9	3	325.4	4.3	319	26	0.05218	0.93906	0.37800	1.53439	0.05271	1.78334	0.56609	-2.78997
15YP13-033.FIN2	379.8	4.7	396	9	476	34	0.06069	1.26874	0.47800	2.71967	0.05610	2.85205	0.25535	20.21008
15YP13-011.FIN2	388.9	4.8	387.7	7.3	390	34	0.06210	1.23994	0.46500	2.15054	0.05390	2.59740	0.19275	0.28205
15YP13-039.FIN2	492.4	5.9	492.6	6.6	478	30	0.07939	1.24701	0.62500	1.76000	0.05680	2.11268	0.15514	-3.01255
15YP13-112.FIN2	573.6	7.3	563	10	538	38	0.09310	1.28894	0.74300	2.42261	0.05770	2.77296	0.12634	-6.61710
15YP13-080.FIN2	631.1	8.2	625.5	8.4	590	32	0.10290	1.36054	0.85000	1.76471	0.05900	2.20339	0.35501	-6.96610
15YP13-122.FIN2	634.2	7.9	639.3	8.7	643	27	0.10340	1.25725	0.87800	1.82232	0.06140	1.95440	0.56741	1.36858
15YP13-108.FIN2	680.2	6.9	671.3	9	643	26	0.11130	1.07817	0.93800	1.81237	0.06110	2.12766	0.25811	-5.78538
15YP13-008.FIN2	824.7	8.7	826.8	7.8	849	19	0.13650	1.09890	1.25900	1.35028	0.06740	1.78042	0.45459	2.86219
15YP13-029.FIN2	950	11	967	12	994	23	0.15870	1.26024	1.59300	1.82046	0.07260	2.06612	0.45651	4.42656
15YP13-109.FIN2	2464	22	2531	11	2579	15	0.46570	1.09513	11.08000	1.26354	0.17200	1.45349	0.74060	4.45909

Table 6: LA-ICP-MS Zircon Isotopic and Age Data Table: 15YP14: SGTHW Terrigenous

	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP14																
15YP14-093	75.51208	3.59249	74.80694	5.84970	52.33157	149.92087	0.01178	4.78676	0.07646	8.13472	0.04708	6.57729	0.00341	17.01938	0.55773	-44.29545
15YP14-022	76.51551	3.63479	84.65529	9.03026	320.77530	214.39552	0.01194	4.77999	0.08695	11.16753	0.05284	10.09284	0.00337	18.30498	0.30542	76.14669
15YP14-067	77.34805	2.87992	76.94636	6.63134	64.48798	183.60699	0.01207	3.74655	0.07873	8.97809	0.04732	8.15902	0.00330	17.39346	0.35125	-19.94181
15YP14-115	78.23547	3.38458	78.91119	5.14144	99.41996	118.82464	0.01221	4.35359	0.08082	6.78911	0.04802	5.20944	0.00303	16.82212	0.61839	21.30808
15YP14-091	78.71909	4.29646	104.93110	13.37479	750.44111	241.03538	0.01229	5.49318	0.10887	13.50496	0.06430	12.33729	0.00402	24.91970	0.20036	89.51029
15YP14-039	78.72911	4.05343	81.02014	8.63037	149.10423	215.92231	0.01229	5.18172	0.08306	11.13000	0.04905	9.85021	0.00370	19.25000	0.35097	47.19861
15YP14-011	78.73603	3.08900	81.68229	4.80722	168.71543	106.27590	0.01229	3.94819	0.08377	6.13969	0.04946	4.70186	0.00343	15.48065	0.61168	53.33206
15YP14-034	78.78255	3.11922	77.24835	5.30880	30.03866	136.62421	0.01230	3.98448	0.07905	7.15581	0.04665	5.94386	0.00346	16.02252	0.50730	-162.27049
15YP14-096	79.12303	3.40486	80.71037	8.43974	127.95021	220.39242	0.01235	4.33086	0.08273	10.92326	0.04861	10.02802	0.00356	16.72646	0.31378	38.16108
15YP14-085	79.18401	3.33249	80.97533	6.42174	134.14649	159.13590	0.01236	4.23553	0.08301	8.27706	0.04874	7.11126	0.00377	16.47316	0.46335	40.97199
15YP14-090	79.30952	3.24060	78.88037	6.18869	65.90009	160.22806	0.01238	4.11224	0.08078	8.17926	0.04735	7.07034	0.00350	16.38313	0.43281	-20.34812
15YP14-122	79.34341	4.16774	77.88249	12.29005	33.28358	336.99426	0.01238	5.28689	0.07972	16.49279	0.04671	15.62245	0.00359	22.32746	0.20801	-138.38604
15YP14-094	79.49740	3.27168	80.35873	9.48342	106.04127	253.67398	0.01241	4.14194	0.08236	12.33200	0.04816	11.61562	0.00350	18.92869	0.25633	25.03164
15YP14-033	79.60117	3.01368	76.03921	5.09802	-34.54130	136.03004	0.01242	3.81029	0.07776	6.97613	0.04541	5.84363	0.00338	16.74735	0.48848	330.45215
15YP14-050	79.99389	2.92881	80.79010	6.45528	104.39742	167.88182	0.01249	3.68490	0.08282	8.33876	0.04813	7.48040	0.00347	17.00358	0.36928	23.37561
15YP14-038	80.45604	3.71057	78.93237	9.50809	33.04855	258.54541	0.01256	4.64209	0.08084	12.57894	0.04670	11.69105	0.00371	21.25425	0.23807	-143.44802
15YP14-002	80.62293	3.12727	80.81577	5.75740	86.51973	143.50687	0.01259	3.90414	0.08284	7.43242	0.04776	6.32444	0.00378	16.83445	0.45619	6.81555
15YP14-108	80.68275	3.44559	88.49083	6.28137	304.55495	132.64335	0.01259	4.29847	0.09106	7.43511	0.05246	6.06663	0.00401	16.56680	0.54807	73.50798
15YP14-037	81.54325	3.39205	84.28878	7.13660	162.78353	172.89810	0.01273	4.18728	0.08655	8.85421	0.04934	7.80153	0.00367	17.60097	0.36136	49.90694
15YP14-116	81.57439	3.68438	82.89985	8.52695	121.25559	214.89301	0.01273	4.54652	0.08507	10.75654	0.04847	9.74846	0.00379	23.62315	0.32705	32.72525
15YP14-097	81.58494	3.53585	79.95803	5.11310	31.61270	116.55468	0.01274	4.36263	0.08193	6.66659	0.04668	5.04092	0.00372	16.76175	0.62743	-158.07645
15YP14-125	81.78240	3.39299	83.05015	7.40041	119.66157	185.29133	0.01277	4.17627	0.08523	9.31406	0.04844	8.32529	0.00382	17.75441	0.37420	31.65525
15YP14-102	82.09121	3.61792	81.90990	8.08005	76.62599	207.36749	0.01282	4.43656	0.08401	10.30875	0.04756	9.30523	0.00367	17.45269	0.33738	-7.13232
15YP14-105	82.09920	3.85246	80.33146	9.48980	28.07048	252.90725	0.01282	4.72380	0.08233	12.34437	0.04661	11.40478	0.00356	17.74556	0.30618	-192.47521
15YP14-072	82.11141	2.73923	83.83507	6.92244	133.21566	176.99500	0.01282	3.35799	0.08607	8.63217	0.04872	7.95225	0.00342	15.94918	0.26627	38.36205
15YP14-109	82.11689	4.75728	79.26424	11.28966	-5.90155	301.18697	0.01282	5.83243	0.08119	14.88884	0.04595	13.69892	0.00328	25.38448	0.31270	1491.44730
15YP14-099	82.13634	3.52221	83.01251	5.70551	108.29400	130.13334	0.01282	4.31680	0.08519	7.17800	0.04821	5.73488	0.00378	16.40197	0.56338	24.15430
15YP14-140	82.98080	3.55045	84.38729	7.26145	124.37139	176.20967	0.01296	4.30742	0.08666	8.99957	0.04853	7.90180	0.00373	18.73138	0.41495	33.27983
15YP14-040	83.51887	3.59075	79.28726	5.12564	-46.44441	121.02018	0.01304	4.32845	0.08122	6.73733	0.04519	5.16295	0.00362	17.41661	0.60642	279.82547
15YP14-107	83.57271	4.49592	86.96681	11.72597	181.16259	279.17135	0.01305	5.41649	0.08942	14.15048	0.04973	13.07278	0.00386	27.11656	0.29286	53.86867
15YP14-135	84.16682	3.26226	84.92906	7.14941	106.41294	176.61774	0.01314	3.90229	0.08724	8.80602	0.04817	7.89419	0.00326	17.52733	0.37238	20.90547
15YP14-138	84.24271	3.72796	81.01847	5.29218	-13.04517	120.09592	0.01315	4.45552	0.08306	6.81388	0.04582	5.15531	0.00393	16.99709	0.63134	745.77689
15YP14-089	86.64735	4.65171	86.51942	5.76442	82.99075	101.20336	0.01353	5.40667	0.08894	6.97023	0.04769	4.39909	0.00335	16.06452	0.76856	-4.40603
15YP14-048	99.60532	4.18145	107.50560	10.79885	286.28595	209.09871	0.01557	4.23191	0.11169	10.64256	0.05204	9.76499	0.00449	19.88814	0.31162	65.20775
15YP14-031	100.41263	4.31043	101.19093	10.07894	119.56279	211.58480	0.01570	4.32768	0.10479	10.51698	0.04844	9.58531	0.00436	17.83321	0.28311	16.01682
15YP14-092	101.75563	4.40155	108.17882	10.10857	252.01062	192.52896	0.01591	4.36133	0.11242	9.90012	0.05127	8.88770	0.00441	17.40254	0.36201	59.62248
15YP14-055	101.95486	4.69575	103.72112	8.63041	144.49164	166.31866	0.01594	4.64392	0.10755	8.79031	0.04895	7.46348	0.00495	16.70098	0.45925	29.43892
15YP14-076	106.72604	4.67542	105.02156	8.18554	66.52249	157.65083	0.01669	4.41873	0.10897	8.23734	0.04736	6.95187	0.00406	16.35816	0.48033	-60.43602
15YP14-065	234.08553	8.75598	234.66167	15.58677	240.43505	142.37414	0.03698	3.81142	0.25999	7.49669	0.05101	6.45550	0.00995	15.70730	0.44809	2.64084
15YP14-130	239.69598	10.24255	226.92157	19.50457	96.51158	192.88456	0.03788	4.35654	0.25043	9.68421	0.04797	8.64896	0.01003	18.59944	0.35234	-148.35981
15YP14-119	270.87078	9.49738	264.89653	13.81233	212.39122	106.88666	0.04291	3.58306	0.29808	5.96441	0.05040	4.76821	0.01152	16.31622	0.56772	-27.53389
15YP14-058	271.09600	11.28438	275.90150	23.14630	316.85699	186.72479	0.04295	4.25436	0.31222	9.69071	0.05275	8.70690	0.01236	16.90747	0.32995	14.44216
15YP14-118	308.61687	10.86662	350.16959	22.95836	635.84101	143.10924	0.04904	3.60907	0.41180	7.84003	0.06093	6.95994	0.01536	17.54552	0.39917	51.46320
15YP14-047	309.41576	12.70254	312.49861	22.39402	335.55978	157.27314	0.04917	4.20879	0.36038	8.41782	0.05318	7.29011	0.01349	17.19502	0.44146	7.79117
15YP14-080	311.63300	12.40182	322.63834	23.24374	402.85274	158.99742	0.04953	4.08051	0.37403	8.50636	0.05479	7.46374	0.01480	17.17594	0.42328	22.64345
15YP14-004	312.51565	13.06935	316.33477	21.13607	344.56380	142.48192	0.04967	4.28852	0.36553	7.85780	0.05339	6.58435	0.01245	16.72936	0.50076	9.30108
15YP14-117	319.84492	11.98602	319.45378	18.58476	316.60253	123.84691	0.05087	3.84476	0.36973	6.84317	0.05274	5.66099	0.01407	16.91167	0.52914	-1.02412
15YP14-071	320.19988	11.92915	323.07937	15.05306	343.88601	86.50410	0.05093	3.82236	0.37463	5.48026	0.05338	3.92719	0.01437	15.10251	0.68629	6.88779
15YP14-009	321.16694	10.86955	316.22126	16.31296	279.93377	109.65542	0.05108	3.47233	0.36538	6.05212	0.05190	4.95693	0.01385	16.05757	0.52773	-14.72961
15YP14-112	323.49086	13.09225	323.57358	16.40734	324.16892	94.53424	0.05146	4.15379	0.37530	5.96955	0.05292	4.28736	0.01447	16.14093	0.67630	0.20917
15YP14-006	324.24554	9.73561	319.98234	17.27800	289.06214	122.12119	0.05159	3.08101	0.37044	6.34896	0.05211	5.55128	0.01314	17.42926	0.38370	-12.17157
15YP14-077	324.48475	12.78777	322.80949	15.73565	310.74182	89.98072	0.05162	4.04497	0.37426	5.73477	0.05260	4.06518	0.01414	15.38687	0.69381	-4.42262
15YP14-133	324.59058	12.21526	322.90350	16.54930	310.75446	102.16828	0.05164	3.86248	0.37439	6.03223	0.05260	4.63347	0.01448	17.05123	0.61952	-4.45243
15YP14-024	326.19464	12.20885	317.92655	17.74886	257.76807	117.78581	0.05190	3.84194	0.36767	6.55939	0.05140	5.31649	0.01425	15.73665	0.56082	-26.54579
15YP14-016	326.66479	11.46775	334.37264	16.67546	388.34362	101.64859	0.05198	3.60346	0.39000	5.90154	0.05444	4.67368	0.01455	16.26852	0.57210	15.88254
15YP14-030	327.54660	11.19040	313.01534	17.77151	206.15902	126.18644	0.05212	3.50700	0.36107	6.65560	0.05026	5.65667	0.01374	16.28574	0.46707	-58.88056
15YP14-113	329.54916	11.77693	326.85912	14.45401	307.74570	82.08657	0.05245	3.66912	0.37976	5.20895	0.05253	3.69739	0.01513	16.18156	0.68971	-7.08489
15YP14-042	329.69668	11.42933	330.57770	14.42235	336.78370	82.14140	0.05247	3.55918	0.38482	5.14790	0.05321	3.71930	0.01368	15.58312	0.66628	2.10433
15YP14-139	330.06538	12.83364	333.14958	21.19112	354.74192	138.33054	0.05253	3.99257	0.38833	7.53971	0.05363	6.39583	0.01463	18.39212	0.47696	6.95620
15YP14-069	330.26723	12.19561	323.08599	17.33112	271.64407	111.85133	0.05257	3.79163	0.37464	6.31661	0.05171	5.05204	0.01391	16.05637	0.56958	-21.58087
15YP14-010	330.43935	12.03963	325.02722	16.51678	286.43837	103.47400	0.05260	3.74119	0.37727	5.98687	0.05205	4.67397	0.01385	15.55740	0.60423	-15.36141
15YP14-128	332.80879	13.14481	342.93654	25.22599	412.15176	165.19007	0.05298	4.05663	0.40178	8.77643	0.05502	7.78264	0.01566	17.94936	0.40511	19.25091
15YP14-029	333.16984	10.56799	333.81143	15.59334	338.28464	98.00205	0.05304	3.25730	0.38924	5.52346	0.05325	4.46078	0.01502	15.99386	0.55682	1.51198
15YP14-044	333.47043	13.55063	341.72788	17.76247	398.27928	98.89564	0.05309	4.17391	0.40011	6.17534	0.05468	4.55118	0.01584	16.89395	0.65673	16.27221
15YP14-129	335.11337	12.57230	331.15463	18.27968	303.43227	115.82751	0.05336	3.85377	0.38561	6.52754	0.05244	5.26852	0.01600	17.85914	0.56137	-10.44091
15YP14-049	338.60418	13.27439	331.45598	15.80901	281.57720	87.70990	0.05393	4.02833	0.38602	5.63407	0.05194	3.93894	0.01459	15.77386	0.69601	-20.25270
15YP14-086	339.49497	14.14245	359.00979	21.13859	487.14316	119.41111	0.05408	4.28108	0.42414	7.06342	0.05691	5.61821	0.01663	15.74906	0.59247	30.30899
15YP14-026	342.78888	13.92364	334.78466	23.79260	279.54199	159.76453	0.05461	4.17533	0.39057	8.44122	0.05189	7.33627	0.01495	16.18497	0.43639	-22.62518
15YP14-131	347.14814	13.84637	344.23186	20.09485	324.59246	122.65790	0.05533	4.10137	0.40357	6.95147	0.05293	5.61264	0.01533	17.68178	0.55333	-6.94892
15YP14-015	347.67095	11.98593	376.19988	16.22239	555.83444	80.94458	0.05541	3.54459	0.44846	5.20166	0.05872	3.80699	0.01702	15.44666	0.66244	37.45063
15YP14-098	365.46326	13.33925	359.82984	20.01660	323.66547	120.57775	0.05833	3.75828	0.42529	6.67211	0.05290	5.51292	0.01623	16.30514	0.52617	-12.91389

Table 6 cont: LA-ICP-MS Zircon Isotopic and Age Data Table: 15G001: Murdunu-Goynuk volcanic

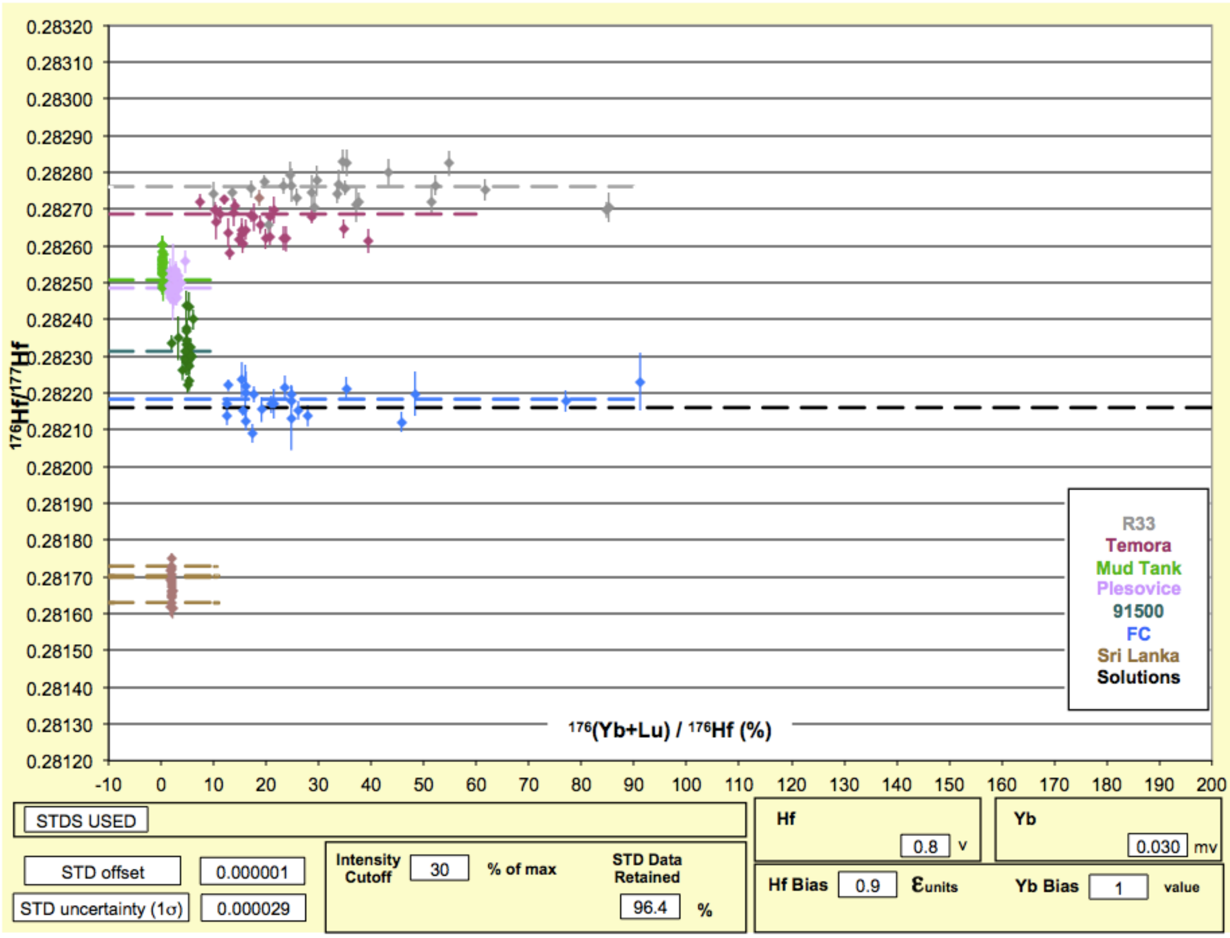
	Dates (Ma)						Isotopic Ratios									
Sample-Grain #	206Pb/238U age	±2σ	207Pb/235U age	±2σ	207Pb/206Pb age	±2σ	206Pb/238U c	±2σ	207Pb/235U c	±2σ	207Pb/206Pb c	±2σ	208Pb/232Th c	±2_%	Rho (ρ)	% disc b
15YP14-075	377.46368	13.40952	376.37567	21.21014	369.68539	124.52972	0.06030	3.66136	0.44871	6.81511	0.05399	5.74806	0.01608	16.68522	0.47091	-2.10403
15YP14-052	379.50392	14.45422	377.85778	19.42194	367.78082	105.04791	0.06064	3.92632	0.45083	6.21483	0.05395	4.81747	0.01673	16.20868	0.59554	-3.18752
15YP14-041	388.64977	13.20696	390.45788	18.14337	401.18287	96.25207	0.06214	3.50522	0.46894	5.64754	0.05475	4.42811	0.01699	15.79037	0.59184	3.12404
15YP14-001	389.41580	12.61519	393.10068	16.08954	414.83467	80.33975	0.06227	3.34162	0.47277	4.97558	0.05509	3.68646	0.01774	16.48950	0.65118	6.12747
15YP14-095	397.74386	13.91421	388.36437	16.62071	332.86415	82.45357	0.06364	3.61121	0.46592	5.19254	0.05312	3.73117	0.01650	16.02445	0.68091	-19.49135
15YP14-045	397.78280	13.06847	401.23300	18.50275	421.15001	97.40482	0.06365	3.39117	0.48461	5.63362	0.05524	4.49862	0.01740	15.94649	0.57346	5.54843
15YP14-053	402.95793	14.99602	335.57846	21.02015	-108.62490	149.62359	0.06450	3.84348	0.39166	7.43252	0.04406	6.36161	0.01281	18.69414	0.49357	470.96277
15YP14-020	404.02491	15.01234	402.71007	18.28970	395.17420	87.52489	0.06468	3.83782	0.48677	5.55151	0.05461	4.01129	0.01736	15.33018	0.67930	-2.23970
15YP14-019	404.68439	13.68916	394.86252	16.65429	337.74928	83.01137	0.06479	3.49367	0.47533	5.13284	0.05323	3.76036	0.01754	16.78566	0.66119	-19.81799
15YP14-054	405.37874	15.23853	395.11637	18.04040	335.49936	87.77788	0.06490	3.88311	0.47570	5.56092	0.05318	3.98062	0.01715	15.55408	0.68578	-20.82847
15YP14-106	405.52203	13.66176	411.81035	18.69693	447.20960	93.95675	0.06493	3.47969	0.50016	5.57409	0.05590	4.35456	0.01820	16.78886	0.60134	9.32171
15YP14-007	406.10507	14.84524	444.56383	21.24614	648.82504	96.13918	0.06502	3.77621	0.54934	5.96359	0.06130	4.61569	0.01890	17.45270	0.59939	37.40916
15YP14-104	410.95988	15.21908	398.96040	18.42622	330.02717	91.22983	0.06583	3.82711	0.48129	5.63616	0.05305	4.13757	0.01775	16.20885	0.65897	-24.52305
15YP14-062	412.21542	14.52709	433.88551	18.40822	550.60693	80.79702	0.06603	3.64213	0.53313	5.26102	0.05858	3.79647	0.01886	15.90491	0.67528	25.13436
15YP14-078	415.39226	16.87935	395.86849	19.53414	283.38286	95.62817	0.06656	4.20130	0.47679	6.01644	0.05198	4.30659	0.01954	16.36153	0.68149	-46.58341
15YP14-057	418.11713	15.93966	400.32819	18.12796	298.89273	86.08912	0.06701	3.94209	0.48329	5.52865	0.05233	3.87633	0.02039	15.83221	0.70052	-39.88869
15YP14-110	446.27183	15.81880	438.72479	21.26692	399.31389	103.80934	0.07168	3.67327	0.54046	6.03281	0.05471	4.78560	0.02063	16.41616	0.57614	-11.75966
15YP14-027	455.84496	19.00443	489.75531	22.08739	651.66830	79.22336	0.07327	4.32457	0.61985	5.74690	0.06138	3.78483	0.04317	20.54439	0.73607	30.04954
15YP14-124	458.78345	18.73277	537.64992	22.65996	887.93094	70.51932	0.07376	4.23631	0.69809	5.48951	0.06867	3.49118	0.04090	16.58158	0.76237	48.33118
15YP14-100	459.12436	16.04980	460.83885	20.05044	469.39429	88.08106	0.07382	3.62622	0.57437	5.46641	0.05646	4.09051	0.02371	19.73859	0.64140	2.18791
15YP14-056	468.90406	19.30887	452.12018	27.58129	367.64432	137.25685	0.07545	4.27585	0.56091	7.66267	0.05394	6.35874	0.02451	18.52196	0.51967	-27.54286
15YP14-087	470.21930	15.85198	456.86022	26.16971	390.20739	135.48510	0.07567	3.49994	0.56822	7.20560	0.05449	6.29850	0.01852	18.48180	0.44166	-20.50497
15YP14-103	474.68096	15.21341	474.55392	22.89698	473.93981	109.46480	0.07641	3.32835	0.59578	6.10857	0.05657	5.12218	0.02132	16.90334	0.49957	-0.15638
15YP14-121	475.77824	16.58193	463.19300	21.77347	401.26244	101.57367	0.07660	3.62007	0.57803	5.91737	0.05476	4.68085	0.02417	18.93317	0.58245	-18.57034
15YP14-081	539.63033	18.86747	571.97321	24.61030	702.69115	90.44481	0.08731	3.65009	0.75647	5.69651	0.06286	4.37345	0.01949	22.59489	0.62776	23.20519
15YP14-032	542.37258	19.31181	538.49575	23.15698	522.11245	89.44391	0.08778	3.71807	0.69951	5.60460	0.05782	4.19375	0.02342	15.50548	0.63830	-3.88042
15YP14-021	557.03816	20.73955	547.83036	27.04450	509.71825	109.83638	0.09025	3.89262	0.71520	6.47340	0.05750	5.17227	0.02156	15.43380	0.57368	-9.28354
15YP14-061	559.45189	19.03199	570.88281	26.00055	616.67014	101.81188	0.09066	3.55690	0.75459	6.03101	0.06039	4.87048	0.02482	15.16964	0.56130	9.27858
15YP14-063	571.70932	24.46410	570.98319	24.38247	568.09304	73.23513	0.09274	4.48016	0.75476	5.65042	0.05905	3.44317	0.02525	15.17508	0.78916	-0.63656
15YP14-066	594.77657	24.65278	604.52461	41.96505	641.24305	169.85850	0.09666	4.34734	0.81369	9.40515	0.06108	8.34012	0.02525	16.97680	0.37321	7.24631
15YP14-003	599.95125	19.75471	597.00345	22.38442	585.82053	76.99490	0.09754	3.45361	0.80031	5.01419	0.05954	3.63520	0.02745	15.88345	0.66206	-2.41212
15YP14-136	608.32648	22.86128	594.84403	23.49998	543.75662	74.94194	0.09896	3.94516	0.79649	5.28103	0.05840	3.51070	0.02713	16.76020	0.73779	-11.87477
15YP14-068	613.75933	24.13346	615.77637	25.49417	623.19986	79.27928	0.09989	4.12995	0.83390	5.59158	0.06057	3.76952	0.02583	15.18640	0.73154	1.51485
15YP14-127	617.12978	25.39795	596.47602	27.36676	518.69931	93.19463	0.10046	4.32414	0.79938	6.14937	0.05773	4.37224	0.02912	16.30142	0.68555	-18.97640
15YP14-059	620.11850	23.74580	617.65734	25.08538	608.64732	78.71547	0.10097	4.02377	0.83731	5.48863	0.06017	3.73287	0.03441	20.16587	0.72092	-1.88470
15YP14-088	623.75045	19.84964	611.21249	29.13251	565.01775	115.45953	0.10160	3.34389	0.82568	6.43585	0.05897	5.49896	0.02609	15.43115	0.46423	-10.39484
15YP14-084	624.23837	24.01577	609.92935	35.07624	557.13576	138.79091	0.10168	4.04402	0.82337	7.78367	0.05876	6.65067	0.02863	16.51235	0.44431	-12.04421
15YP14-046	627.14695	45.58492	636.82100	52.27333	671.30260	169.52920	0.10218	7.65495	0.87231	11.33924	0.06195	8.36541	0.02905	19.60071	0.64714	6.57761
15YP14-008	644.71062	22.82027	634.55266	24.93375	598.53415	81.02208	0.10518	3.72616	0.86813	5.34962	0.05989	3.83851	0.02689	15.32501	0.67596	-7.71493
15YP14-028	652.39907	26.21148	653.99815	28.35815	659.51909	87.59960	0.10650	4.23304	0.90425	5.96432	0.06161	4.20173	0.02730	15.25265	0.68125	1.07958
15YP14-051	655.32491	23.41252	661.24007	29.75221	681.46392	102.19669	0.10700	3.76416	0.91788	6.21301	0.06224	4.94294	0.02731	15.38952	0.57386	3.83571
15YP14-111	656.70621	28.56765	672.26521	48.32698	724.75668	179.41864	0.10724	4.58563	0.93882	10.06678	0.06352	8.96170	0.02798	18.85935	0.38118	9.38942
15YP14-134	899.15977	38.36012	932.65671	34.05700	1012.67278	66.41032	0.14968	4.58429	1.50560	5.67653	0.07299	3.34772	0.04379	17.89404	0.80521	11.20925
15YP14-073	929.46826	35.43226	953.49922	33.72467	1009.37394	73.82330	0.15510	4.10479	1.55756	5.54538	0.07287	3.72852	0.04606	15.10694	0.72884	7.91636
15YP14-079	938.57536	33.28666	933.33028	30.89864	920.96551	69.11365	0.15673	3.82081	1.50726	5.13979	0.06978	3.43786	0.04048	15.26968	0.73068	-1.91211
15YP14-013	995.35988	28.95391	985.68378	27.15208	964.19970	60.52024	0.16696	3.14630	1.63993	4.36275	0.07127	3.02232	0.04605	14.89445	0.71091	-3.23171
15YP14-114	1006.29775	35.01663	999.62752	33.87025	985.02636	77.20110	0.16895	3.76864	1.67643	5.41530	0.07200	3.88881	0.04648	15.74716	0.68851	-2.15947
15YP14-083	1040.62130	32.11508	1029.38786	32.23145	1005.59253	75.14139	0.17519	3.35027	1.75603	5.06189	0.07273	3.79452	0.04553	15.58040	0.63889	-3.48340
15YP14-064	1128.13585	39.03282	1124.99631	32.62492	1118.93971	60.15528	0.19125	3.78296	2.02815	4.87520	0.07695	3.07520	0.05003	15.70123	0.76826	-0.82186
15YP14-123	1865.65248	62.26558	1850.17168	44.66828	1832.81128	65.97737	0.33564	3.86230	5.18509	5.36472	0.11209	3.72328	0.07996	16.52606	0.69889	-1.79185
15YP14-060	1899.99535	67.92572	2203.30897	43.17510	2498.79338	43.33142	0.34277	4.14956	7.75766	4.90373	0.16422	2.61299	0.10001	15.12556	0.84274	23.96349
15YP14-126	1938.21810	57.85639	1932.31669	40.36367	1925.99378	57.37734	0.35076	3.47179	5.70626	4.76596	0.11804	3.26513	0.09204	19.41367	0.71555	-0.63470
15YP14-005	1975.16276	53.10082	1959.35340	40.75788	1942.69397	63.42811	0.35852	3.13418	5.88723	4.79138	0.11915	3.62412	0.08778	15.27862	0.61400	-1.67133
15YP14-012	2017.13740	53.89990	2019.44014	34.31912	2021.79508	43.11323	0.36740	3.12497	6.30709	3.98274	0.12456	2.46916	0.09138	15.74969	0.77919	0.23037
15YP14-120	2023.58616	52.10769	2026.22229	34.52109	2028.90852	45.92934	0.36876	3.01245	6.35606	4.00235	0.12506	2.63515	0.08912	15.84823	0.74661	0.26233
15YP14-023	2029.61384	57.73874	2005.53714	39.73451	1980.82879	56.25921	0.37005	3.33101	6.20772	4.63371	0.12172	3.22113	0.09162	16.56277	0.70204	-2.46286
15YP14-036	2475.26352	88.18076	2478.87442	47.09592	2481.83558	48.01635	0.46811	4.31957	10.48819	5.20014	0.16257	2.89530	0.10239	15.65720	0.82787	0.26481
15YP14-025	2702.01661	76.80338	2679.31892	42.21044	2662.23550	47.90536	0.52067	3.50046	12.99538	4.57135	0.18110	2.94007	0.12491	15.50581	0.75039	-1.49427
15YP14-137	3304.93517	97.37478	3233.75462	45.08452	3189.90311	44.15334	0.66976	3.79445	23.16157	4.73622	0.25092	2.83442	0.15397	18.54981	0.79766	-3.60613

a Isotopic dates calculated using λ238 = 1.55125E-10 (Jaffey et al. 1971) and λ235 = 9.8485E-10 (Jaffey et al. 1971).

b % discordance = 100 - (100 * (206Pb/238U date) / (207Pb/206Pb date))

c Measured ratios corrected for fractionation, tracer, blank and initial common Pb.

Appendix 6: Zircon Hafnium Standard plot



Appendix 7: LA-MC-ICP-MS Zircon Hafnium Data Tables

Table 1: 15KZ01; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	(^{176}Yb + ^{176}Lu) / ^{176}Hf (%)	Volts Hf	$^{176}Hf/^{177}Hf$	± (1s)	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$ (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
1	CAMPBELL-15KZ01-002	22.7	3.2	0.282701	0.000024	0.001443	0.282694	-3.0	0.8	2.2	244
2	CAMPBELL-15KZ01-003	19.1	3.0	0.282161	0.000028	0.001107	0.282155	-22.1	1.0	-15.3	314
3	CAMPBELL-15KZ01-004	15.4	2.9	0.282636	0.000033	0.000982	0.282632	-5.3	1.2	0.2	254
4	CAMPBELL-15KZ01-050	9.0	4.1	0.281783	0.000029	0.000591	0.281772	-35.4	1.0	-12.5	1042
5	CAMPBELL-15KZ01-049	4.3	4.5	0.281974	0.000025	0.000255	0.281971	-28.7	0.9	-14.5	640
6	CAMPBELL-15KZ01-006	27.3	3.8	0.282623	0.000031	0.001648	0.282616	-5.7	1.1	-0.6	241
7	CAMPBELL-15KZ01-007	18.9	3.5	0.282669	0.000031	0.001557	0.282662	-4.1	1.1	1.1	245
8	CAMPBELL-15KZ01-009	19.2	3.7	0.282466	0.000019	0.001194	0.282459	-11.3	0.7	-4.1	335
9	CAMPBELL-15KZ01-010	18.3	3.5	0.282660	0.000030	0.001131	0.282655	-4.4	1.1	0.9	245
10	CAMPBELL-15KZ01-051	18.3	3.3	0.282482	0.000031	0.001120	0.282475	-10.7	1.1	-3.2	348
11	CAMPBELL-15KZ01-054	40.4	3.5	0.282659	0.000029	0.002387	0.282648	-4.5	1.0	0.7	250
12	CAMPBELL-15KZ01-055	20.4	3.4	0.282347	0.000027	0.001126	0.282339	-15.5	1.0	-7.7	363
13	CAMPBELL-15KZ01-056	6.1	4.6	0.281305	0.000023	0.000395	0.281292	-52.3	0.8	-13.7	1739
14	CAMPBELL-15KZ01-057	20.0	2.9	0.282593	0.000030	0.001266	0.282588	-6.8	1.1	-1.4	252
15	CAMPBELL-15KZ01-058	20.0	3.2	0.281703	0.000026	0.001668	0.281670	-38.3	0.9	-16.2	1038
16	CAMPBELL-15KZ01-039	7.1	3.2	0.281273	0.000032	0.000410	0.281257	-53.5	1.1	-7.8	2048
17	CAMPBELL-15KZ01-060	13.9	2.7	0.281982	0.000031	0.000767	0.281973	-28.4	1.1	-13.8	669
18	CAMPBELL-15KZ01-013	8.5	3.7	0.281343	0.000023	0.000545	0.281324	-51.0	0.8	-10.1	1844
19	CAMPBELL-15KZ01-015	17.8	3.8	0.282699	0.000040	0.001377	0.282693	-3.0	1.4	2.3	252
20	CAMPBELL-15KZ01-017	13.9	3.7	0.282644	0.000032	0.000882	0.282639	-5.0	1.1	0.9	270
21	CAMPBELL-15KZ01-018	13.3	3.5	0.282450	0.000031	0.001193	0.282443	-11.8	1.1	-5.0	320
22	CAMPBELL-15KZ01-019	36.1	4.3	0.282370	0.000041	0.001990	0.282357	-14.7	1.5	-7.6	340
23	CAMPBELL-15KZ01-021	22.1	3.4	0.282563	0.000032	0.001356	0.282557	-7.8	1.1	-2.8	235
24	CAMPBELL-15KZ01-028	21.9	3.8	0.282478	0.000028	0.001402	0.282469	-10.9	1.0	-3.4	350
25	CAMPBELL-15KZ01-025	17.6	3.9	0.282334	0.000029	0.001105	0.282320	-15.9	1.0	-1.1	688

Table 1: 15KZ01; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	$(^{176}Yb + ^{176}Lu) / ^{176}Hf$ (%)	Volts Hf	$^{176}Hf/^{177}Hf$	± (1s)	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$ (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
26	CAMPBELL-15KZ01-071	17.8	3.1	0.282437	0.000028	0.001223	0.282430	-12.3	1.0	-5.3	325
27	CAMPBELL-15KZ01-073	8.5	2.0	0.281024	0.000030	0.000567	0.280995	-62.3	1.1	-1.4	2722
28	CAMPBELL-15KZ01-069	17.2	1.9	0.282656	0.000035	0.001207	0.282650	-4.6	1.2	0.8	248
29	CAMPBELL-15KZ01-067	24.9	3.5	0.282686	0.000039	0.001848	0.282678	-3.5	1.4	1.5	238
30	CAMPBELL-15KZ01-075	15.4	2.2	0.282653	0.000032	0.001006	0.282640	-4.7	1.1	9.7	664
31	CAMPBELL-15KZ01-077	7.6	4.2	0.282584	0.000035	0.000546	0.282576	-7.1	1.2	9.8	771
32	CAMPBELL-15KZ01-078	11.9	4.1	0.282618	0.000026	0.000814	0.282606	-5.9	0.9	10.9	773
33	CAMPBELL-15KZ01-065	9.1	3.5	0.282518	0.000027	0.001102	0.282511	-9.4	1.0	-2.6	317
34	CAMPBELL-15KZ01-079	18.6	3.3	0.282566	0.000036	0.001352	0.282558	-7.7	1.3	-0.9	322
35	CAMPBELL-15KZ01-080	10.0	4.3	0.282358	0.000026	0.000598	0.282354	-15.1	0.9	-7.7	341
36	CAMPBELL-15KZ01-082	17.8	3.5	0.282547	0.000026	0.001185	0.282540	-8.4	0.9	-1.5	322
37	CAMPBELL-15KZ01-083	6.9	3.6	0.282487	0.000030	0.000724	0.282483	-10.5	1.1	-3.8	311
38	CAMPBELL-15KZ01-084	12.0	3.7	0.282616	0.000026	0.000769	0.282612	-6.0	0.9	-0.4	259
39	CAMPBELL-15KZ01-087	14.4	3.8	0.282632	0.000027	0.000988	0.282628	-5.4	1.0	0.0	250
40	CAMPBELL-15KZ01-090	11.5	3.5	0.282425	0.000024	0.000709	0.282421	-12.7	0.9	-5.7	321
41	CAMPBELL-15KZ01-091	12.1	2.7	0.282630	0.000038	0.000782	0.282627	-5.5	1.3	0.0	251
42	CAMPBELL-15KZ01-093	19.3	1.9	0.282601	0.000034	0.001347	0.282595	-6.5	1.2	-1.6	228
43	CAMPBELL-15KZ01-094	9.1	3.3	0.282087	0.000039	0.000654	0.282079	-24.7	1.4	-10.8	636
44	CAMPBELL-15KZ01-095	31.1	3.5	0.282637	0.000030	0.001770	0.282628	-5.2	1.1	0.2	258
45	CAMPBELL-15KZ01-096	46.2	3.1	0.282648	0.000026	0.002880	0.282635	-4.9	0.9	-0.2	229
46	CAMPBELL-15KZ01-097	23.3	2.6	0.282553	0.000045	0.001769	0.282542	-8.2	1.6	-1.5	318
47	CAMPBELL-15KZ01-098	14.8	3.6	0.282517	0.000041	0.000962	0.282511	-9.5	1.4	-2.6	317
48	CAMPBELL-15KZ01-099	13.3	3.4	0.282508	0.000025	0.000794	0.282504	-9.8	0.9	-2.6	330
49	CAMPBELL-15KZ01-100	23.1	3.4	0.282440	0.000036	0.001486	0.282431	-12.2	1.3	-5.2	329

Table 2: 15YP11; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	$(^{176}Yb + ^{176}Lu) / ^{176}Hf$ (%)	Volts Hf	$^{176}Hf/^{177}Hf$	± (1s)	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$ (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
50	CAMPBELL-15YP11-003	17.8	3.4	0.282851	0.000021	0.001435	0.282849	2.3	0.7	3.5	55
51	CAMPBELL-15YP11-008	33.0	3.5	0.282845	0.000019	0.002264	0.282843	2.1	0.7	3.2	51
52	CAMPBELL-15YP11-009	8.9	3.6	0.282926	0.000015	0.000889	0.282925	5.0	0.5	6.1	51
53	CAMPBELL-15YP11-010	17.0	3.4	0.282942	0.000022	0.001287	0.282941	5.6	0.8	6.7	51
54	CAMPBELL-15YP11-017	16.3	3.5	0.282858	0.000017	0.001331	0.282857	2.6	0.6	3.7	53
55	CAMPBELL-15YP11-146	21.0	3.2	0.282909	0.000018	0.001780	0.282907	4.4	0.6	5.5	51
56	CAMPBELL-15YP11-028	18.3	4.0	0.282917	0.000018	0.001417	0.282916	4.7	0.6	5.7	50
57	CAMPBELL-15YP11-029	19.9	3.6	0.282992	0.000020	0.001567	0.282991	7.3	0.7	8.4	51
58	CAMPBELL-15YP11-129	25.0	3.3	0.282953	0.000018	0.001855	0.282952	6.0	0.6	7.1	53
59	CAMPBELL-15YP11-125	31.0	3.3	0.282933	0.000026	0.002234	0.282931	5.2	0.9	6.3	50
60	CAMPBELL-15YP11-042	20.1	3.6	0.282926	0.000021	0.001478	0.282925	5.0	0.7	6.1	51
61	CAMPBELL-15YP11-121	22.4	3.4	0.282892	0.000020	0.001849	0.282890	3.8	0.7	4.9	52
62	CAMPBELL-15YP11-120	23.0	3.5	0.282937	0.000020	0.001783	0.282935	5.4	0.7	6.5	54
63	CAMPBELL-15YP11-119	12.2	3.6	0.282869	0.000015	0.000998	0.282868	3.0	0.5	4.1	54
64	CAMPBELL-15YP11-118	16.1	3.6	0.282914	0.000022	0.001197	0.282913	4.6	0.8	5.7	51
65	CAMPBELL-15YP11-058	17.7	3.6	0.282895	0.000016	0.001314	0.282894	3.9	0.6	4.9	50
66	CAMPBELL-15YP11-059	21.3	3.4	0.282926	0.000018	0.001593	0.282924	5.0	0.6	6.1	55
67	CAMPBELL-15YP11-062	19.9	3.4	0.282875	0.000019	0.001535	0.282873	3.2	0.7	4.3	52
68	CAMPBELL-15YP11-065	15.7	3.6	0.282980	0.000023	0.001128	0.282979	6.9	0.8	8.0	50
69	CAMPBELL-15YP11-095	21.0	3.3	0.282854	0.000022	0.001765	0.282852	2.4	0.8	3.5	52
70	CAMPBELL-15YP11-071	15.8	3.2	0.282914	0.000023	0.001433	0.282913	4.6	0.8	5.6	47
71	CAMPBELL-15YP11-074	15.1	3.5	0.282898	0.000016	0.001189	0.282897	4.0	0.6	5.1	52

Table 3:15YP04; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	$(^{176}Yb + ^{176}Lu) / ^{176}Hf$ (%)	Volts Hf	$^{176}Hf/^{177}Hf$	± (1s)	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$ (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
72	CAMPBELL-15YP04-004	16.9	2.0	0.282627	0.000037	0.000978	0.282622	-5.6	1.3	1.3	318
73	CAMPBELL-15YP04-008	16.9	1.1	0.282085	0.000037	0.001123	0.282078	-24.7	1.3	-17.7	329
74	CAMPBELL-15YP04-010	8.7	4.7	0.281911	0.000027	0.000542	0.281901	-30.9	0.9	-7.8	1049
75	CAMPBELL-15YP04-011	16.3	3.2	0.282438	0.000026	0.001088	0.282431	-12.3	0.9	-5.4	320
76	CAMPBELL-15YP04-012	21.7	3.1	0.282433	0.000030	0.001351	0.282425	-12.4	1.1	-5.6	322
77	CAMPBELL-15YP04-013	70.6	2.0	0.282389	0.000071	0.004285	0.282360	-14.0	2.5	-7.2	352
78	CAMPBELL-15YP04-015	19.2	2.5	0.282497	0.000036	0.001412	0.282488	-10.2	1.3	-3.3	322
79	CAMPBELL-15YP04-016	12.5	2.8	0.282378	0.000026	0.000740	0.282374	-14.4	0.9	-7.4	321
80	CAMPBELL-15YP04-018	14.6	2.5	0.282403	0.000033	0.000897	0.282397	-13.5	1.2	-6.5	325
81	CAMPBELL-15YP04-021	21.1	3.4	0.282381	0.000039	0.001311	0.282373	-14.3	1.4	-7.2	330
82	CAMPBELL-15YP04-032	12.8	3.7	0.282439	0.000023	0.000843	0.282434	-12.2	0.8	-5.1	328
83	CAMPBELL-15YP04-034	15.8	3.8	0.282331	0.000025	0.001034	0.282324	-16.1	0.9	-9.0	326
84	CAMPBELL-15YP04-047	17.5	3.6	0.282359	0.000017	0.001084	0.282352	-15.1	0.6	-8.1	323
85	CAMPBELL-15YP04-048	25.8	2.2	0.282359	0.000020	0.001439	0.282349	-15.1	0.7	-7.1	376
86	CAMPBELL-15YP04-050	20.1	3.0	0.282401	0.000016	0.001274	0.282393	-13.6	0.6	-6.4	337
87	CAMPBELL-15YP04-049	7.6	2.8	0.281789	0.000019	0.000450	0.281784	-35.2	0.7	-22.2	592
88	CAMPBELL-15YP04-052	27.8	2.1	0.282407	0.000031	0.001559	0.282397	-13.4	1.1	-6.1	342
89	CAMPBELL-15YP04-056	16.8	4.2	0.282521	0.000019	0.001152	0.282513	-9.4	0.7	-2.2	335
90	CAMPBELL-15YP04-061	31.9	2.6	0.282404	0.000023	0.002126	0.282391	-13.5	0.8	-6.7	325
91	CAMPBELL-15YP04-062	28.4	1.5	0.281970	0.000039	0.001525	0.281954	-28.8	1.4	-17.3	544
92	CAMPBELL-15YP04-066	14.8	1.6	0.281718	0.000026	0.001011	0.281696	-37.7	0.9	-12.6	1156
93	CAMPBELL-15YP04-071	24.4	1.8	0.282417	0.000026	0.001530	0.282407	-13.0	0.9	-6.2	322
94	CAMPBELL-15YP04-079	13.4	3.4	0.282379	0.000021	0.000867	0.282374	-14.4	0.8	-7.3	324
95	CAMPBELL-15YP04-080	18.4	3.0	0.282440	0.000021	0.001175	0.282433	-12.2	0.8	-5.1	331
96	CAMPBELL-15YP04-081	14.2	3.3	0.282473	0.000017	0.000843	0.282468	-11.0	0.6	-4.0	322
97	CAMPBELL-15YP04-082	14.1	3.5	0.281994	0.000022	0.000787	0.281985	-28.0	0.8	-14.8	607
98	CAMPBELL-15YP04-087	44.0	2.7	0.282369	0.000024	0.002628	0.282352	-14.7	0.9	-8.0	328
99	CAMPBELL-15YP04-089	32.4	1.6	0.282464	0.000024	0.001904	0.282452	-11.4	0.9	-4.3	338
100	CAMPBELL-15YP04-090	13.4	1.8	0.282750	0.000028	0.000934	0.282739	-1.2	1.0	12.5	632
101	CAMPBELL-15YP04-096	29.4	3.0	0.282375	0.000025	0.001575	0.282366	-14.5	0.9	-7.6	326
102	CAMPBELL-15YP04-100	20.1	2.0	0.282507	0.000027	0.001456	0.282498	-9.8	1.0	-2.8	329
103	CAMPBELL-15YP04-108	17.0	1.4	0.282415	0.000036	0.001104	0.282403	-13.1	1.3	-0.6	580
104	CAMPBELL-15YP04-111	16.7	2.8	0.282420	0.000023	0.001056	0.282414	-12.9	0.8	-5.9	326
105	CAMPBELL-15YP04-133	4.1	3.1	0.282303	0.000020	0.000241	0.282302	-17.0	0.7	-9.7	331
106	CAMPBELL-15YP04-132	10.1	2.6	0.282093	0.000021	0.000826	0.282082	-24.5	0.8	-9.6	684
107	CAMPBELL-15YP04-135	21.6	4.2	0.282485	0.000019	0.001383	0.282476	-10.6	0.7	-3.5	336
108	CAMPBELL-15YP04-131	8.3	3.7	0.282311	0.000022	0.000572	0.282303	-16.8	0.8	-1.9	678

Table 4:15YP14; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	$(^{176}Yb + ^{176}Lu) / ^{176}Hf$ (%)	Volts Hf	$^{176}Hf/^{177}Hf$	± (1s)	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$ (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
111	CAMPBELL-15YP14-012	5.0	2.2	0.281647	0.000028	0.000279	0.281637	-40.2	1.0	5.0	2017
112	CAMPBELL-15YP14-009	13.9	1.8	0.282512	0.000024	0.000979	0.282506	-9.7	0.9	-2.7	321
113	CAMPBELL-15YP14-022	20.6	1.4	0.282901	0.000027	0.001486	0.282899	4.1	1.0	5.7	77
114	CAMPBELL-15YP14-025	9.1	1.3	0.280990	0.000037	0.000570	0.280960	-63.5	1.3	-3.1	2702
115	CAMPBELL-15YP14-031	23.3	1.3	0.283059	0.000039	0.001596	0.283056	9.7	1.4	11.8	100
116	CAMPBELL-15YP14-032	7.3	1.9	0.282752	0.000030	0.000514	0.282747	-1.2	1.1	10.7	542
117	CAMPBELL-15YP14-036	8.8	2.4	0.281362	0.000024	0.000675	0.281330	-50.3	0.8	4.8	2475
118	CAMPBELL-15YP14-039	20.2	2.3	0.282750	0.000024	0.001465	0.282748	-1.2	0.8	0.4	79
119	CAMPBELL-15YP14-048	18.5	3.3	0.282955	0.000025	0.001342	0.282952	6.0	0.9	8.1	100
120	CAMPBELL-15YP14-049	24.1	2.6	0.282617	0.000023	0.002053	0.282604	-5.9	0.8	1.1	339
121	CAMPBELL-15YP14-051	10.5	1.6	0.282549	0.000029	0.000591	0.282542	-8.3	1.0	6.0	655
122	CAMPBELL-15YP14-052	26.4	2.5	0.282603	0.000022	0.001755	0.282590	-6.4	0.8	1.6	380
123	CAMPBELL-15YP14-054	19.6	3.3	0.282344	0.000019	0.001253	0.282335	-15.6	0.7	-6.9	405
124	CAMPBELL-15YP14-056	11.5	2.9	0.282347	0.000020	0.000758	0.282340	-15.5	0.7	-5.3	469
125	CAMPBELL-15YP14-057	22.2	2.7	0.282385	0.000027	0.001526	0.282373	-14.2	0.9	-5.3	418
126	CAMPBELL-15YP14-058	17.6	1.3	0.282484	0.000032	0.001051	0.282479	-10.6	1.1	-4.8	271
127	CAMPBELL-15YP14-055	29.5	1.5	0.282856	0.000031	0.002111	0.282852	2.5	1.1	4.6	102
128	CAMPBELL-15YP14-060	15.9	3.2	0.281181	0.000026	0.000862	0.281150	-56.7	0.9	-15.0	1900
129	CAMPBELL-15YP14-061	20.2	3.6	0.282424	0.000020	0.001324	0.282410	-12.8	0.7	-0.8	559
130	CAMPBELL-15YP14-064	24.3	2.0	0.282232	0.000037	0.001542	0.282199	-19.5	1.3	4.6	1128
131	CAMPBELL-15YP14-068	24.5	2.8	0.282224	0.000022	0.001382	0.282208	-19.9	0.8	-6.7	614
132	CAMPBELL-15YP14-071	26.7	2.8	0.282574	0.000027	0.001873	0.282563	-7.5	0.9	-0.7	320
133	CAMPBELL-15YP14-088	32.7	2.6	0.282503	0.000018	0.001934	0.282481	-10.0	0.6	3.2	624
134	CAMPBELL-15YP14-075	12.1	3.1	0.282725	0.000017	0.000788	0.282720	-2.1	0.6	6.1	377
135	CAMPBELL-15YP14-083	7.7	1.9	0.282152	0.000029	0.000466	0.282143	-22.4	1.0	0.6	1041
136	CAMPBELL-15YP14-080	8.0	1.9	0.282603	0.000031	0.000521	0.282600	-6.4	1.1	0.4	312
138	CAMPBELL-15YP14-099	24.2	3.6	0.282720	0.000022	0.001545	0.282717	-2.3	0.8	-0.6	82
139	CAMPBELL-15YP14-096	21.9	3.4	0.282739	0.000017	0.001419	0.282737	-1.6	0.6	0.1	79
140	CAMPBELL-15YP14-098	15.4	4.0	0.282587	0.000016	0.001109	0.282579	-7.0	0.6	0.9	365
141	CAMPBELL-15YP14-095	13.5	3.5	0.282318	0.000020	0.000857	0.282311	-16.5	0.7	-7.9	398
142	CAMPBELL-15YP14-091	16.2	3.4	0.282806	0.000020	0.000972	0.282805	0.8	0.7	2.4	79
143	CAMPBELL-15YP14-089	41.2	2.5	0.282665	0.000032	0.002498	0.282661	-4.3	1.1	-2.5	87
144	CAMPBELL-15YP14-107	9.0	1.6	0.282678	0.000035	0.000854	0.282677	-3.8	1.3	-2.0	84
145	CAMPBELL-15YP14-104	22.9	2.6	0.282313	0.000023	0.001499	0.282301	-16.7	0.8	-8.0	411
146	CAMPBELL-15YP14-100	16.6	2.0	0.282236	0.000025	0.000941	0.282228	-19.4	0.9	-9.5	459
147	CAMPBELL-15YP14-114	24.1	1.5	0.282200	0.000031	0.001306	0.282175	-20.7	1.1	1.0	1006
148	CAMPBELL-15YP14-119	24.4	2.2	0.282768	0.000028	0.001439	0.282761	-0.6	1.0	5.2	271
149	CAMPBELL-15YP14-122	20.4	2.0	0.282774	0.000028	0.001474	0.282772	-0.4	1.0	1.3	79
150	CAMPBELL-15YP14-123	7.3	3.5	0.281493	0.000019	0.000428	0.281478	-45.7	0.7	-4.1	1866
151	CAMPBELL-15YP14-135	20.1	2.8	0.282725	0.000024	0.001431	0.282723	-2.1	0.9	-0.3	84
152	CAMPBELL-15YP14-137	12.3	2.8	0.280753	0.000020	0.000647	0.280712	-71.9	0.7	2.3	3305
153	CAMPBELL-15YP14-134	26.9	3.0	0.282213	0.000031	0.001323	0.282190	-20.2	1.1	-0.9	899
154	CAMPBELL-15YP14-130	17.2	2.6	0.282555	0.000022	0.001170	0.282549	-8.1	0.8	-3.0	240
155	CAMPBELL-15YP14-131	17.4	3.3	0.282501	0.000018	0.001166	0.282494	-10.0	0.6	-2.6	347
156	CAMPBELL-15YP14-138	5.6	3.1	0.282446	0.000017	0.000492	0.282445	-12.0	0.6	-10.2	84
157	CAMPBELL-15YP14-116	9.9	2.7	0.282615	0.000017	0.000708	0.282614	-6.0	0.6	-4.2	82
158	CAMPBELL-15YP14-125	32.2	1.3	0.282500	0.000041	0.002075	0.282497	-10.1	1.4	-8.4	82
159	CAMPBELL-15YP14-127	22.1	2.5	0.282389	0.000029	0.001545	0.282371	-14.0	1.0	-0.9	617

Table 5:15YP09; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	(^{176}Yb + ^{176}Lu) / ^{176}Hf (%)	Volts Hf	^{176}Hf/^{177}Hf	± (1s)	^{176}Lu/^{177}Hf	^{176}Hf/^{177}Hf (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
160	CAMPBELL-15YP09-007	18.5	3.7	0.282274	0.000026	0.001228	0.282262	-18.1	0.9	-7.1	512
161	CAMPBELL-15YP09-010	4.3	3.2	0.280801	0.000025	0.000259	0.280787	-70.2	0.9	-6.5	2818
162	CAMPBELL-15YP09-015	19.7	2.7	0.282971	0.000024	0.001480	0.282968	6.6	0.9	9.0	115
163	CAMPBELL-15YP09-018	5.7	3.3	0.281101	0.000021	0.000357	0.281087	-59.6	0.7	-14.9	1999
164	CAMPBELL-15YP09-020	9.1	2.9	0.281182	0.000023	0.000540	0.281163	-56.7	0.8	-15.8	1844
165	CAMPBELL-15YP09-021	9.6	3.6	0.282173	0.000025	0.000646	0.282166	-21.6	0.9	-8.2	613
166	CAMPBELL-15YP09-036	8.6	3.4	0.282092	0.000027	0.000541	0.282083	-24.5	1.0	-3.7	943
167	CAMPBELL-15YP09-042	9.2	2.8	0.282133	0.000026	0.000699	0.282124	-23.1	0.9	-8.8	654
168	CAMPBELL-15YP09-045	15.5	3.8	0.281873	0.000019	0.000968	0.281855	-32.2	0.7	-10.2	1016
169	CAMPBELL-15YP09-047	15.3	3.0	0.282418	0.000032	0.000987	0.282411	-13.0	1.1	-4.4	396
170	CAMPBELL-15YP09-049	16.6	2.5	0.282712	0.000032	0.001373	0.282692	-2.6	1.1	14.0	774
171	CAMPBELL-15YP09-053	9.9	3.6	0.282527	0.000028	0.000593	0.282525	-9.1	1.0	-4.5	210
172	CAMPBELL-15YP09-054	8.5	1.9	0.281474	0.000027	0.000778	0.281455	-46.4	1.0	-17.9	1300
173	CAMPBELL-15YP09-055	18.0	1.8	0.282617	0.000033	0.001148	0.282602	-5.9	1.2	9.4	711
174	CAMPBELL-15YP09-061	11.9	2.2	0.281322	0.000026	0.000716	0.281298	-51.7	0.9	-11.8	1812
175	CAMPBELL-15YP09-071	9.6	3.1	0.282164	0.000027	0.000536	0.282154	-22.0	1.0	0.2	1006
176	CAMPBELL-15YP09-075	6.0	4.2	0.281960	0.000024	0.000371	0.281955	-29.2	0.8	-13.7	702
177	CAMPBELL-15YP09-078	24.9	2.1	0.282361	0.000027	0.001449	0.282346	-15.0	1.0	-2.8	573
178	CAMPBELL-15YP09-080	14.1	3.6	0.282587	0.000019	0.000939	0.282586	-7.0	0.7	-5.2	84
179	CAMPBELL-15YP09-085	28.6	2.8	0.280876	0.000027	0.001723	0.280768	-67.5	0.9	3.1	3252
180	CAMPBELL-15YP09-092	9.3	4.0	0.282061	0.000022	0.000572	0.282049	-25.6	0.8	-2.1	1067
181	CAMPBELL-15YP09-093	25.2	3.4	0.281667	0.000028	0.001507	0.281641	-39.5	1.0	-20.0	918
182	CAMPBELL-15YP09-094	7.7	2.6	0.282417	0.000024	0.000525	0.282413	-13.0	0.9	-4.4	391
183	CAMPBELL-15YP09-095	15.2	2.8	0.282269	0.000022	0.001021	0.282251	-18.2	0.8	2.5	954
184	CAMPBELL-15YP09-098	16.7	3.1	0.282295	0.000023	0.001034	0.282287	-17.3	0.8	-9.0	389
185	CAMPBELL-15YP09-100	19.0	2.8	0.282533	0.000020	0.001198	0.282524	-8.9	0.7	-1.1	365
186	CAMPBELL-15YP09-104	19.9	3.5	0.282601	0.000021	0.001203	0.282595	-6.5	0.7	-1.0	259
187	CAMPBELL-15YP09-107	9.8	3.3	0.281131	0.000022	0.000613	0.281102	-58.5	0.8	-4.7	2417
188	CAMPBELL-15YP09-108	15.8	3.5	0.282253	0.000025	0.000878	0.282242	-18.8	0.9	-4.0	681
189	CAMPBELL-15YP09-109	3.7	3.9	0.280990	0.000019	0.000308	0.280975	-63.5	0.7	-5.8	2565
190	CAMPBELL-15YP09-110	10.9	3.8	0.282452	0.000017	0.000739	0.282448	-11.8	0.6	-5.0	313
191	CAMPBELL-15YP09-119	8.1	2.7	0.282628	0.000023	0.000503	0.282621	-5.6	0.8	9.1	667
192	CAMPBELL-15YP09-120	26.7	3.0	0.281576	0.000021	0.001829	0.281502	-42.8	0.8	2.4	2110
193	CAMPBELL-15YP09-122	8.2	2.4	0.282537	0.000027	0.000639	0.282526	-8.8	1.0	9.6	836
194	CAMPBELL-15YP09-123	9.4	4.2	0.281794	0.000026	0.000750	0.281772	-35.1	0.9	-2.0	1502
195	CAMPBELL-15YP09-127	21.5	2.2	0.282688	0.000032	0.001425	0.282670	-3.4	1.1	10.9	669
196	CAMPBELL-15YP09-135	30.2	3.4	0.282520	0.000024	0.001856	0.282517	-9.4	0.9	-7.6	86
197	CAMPBELL-15YP09-136	16.6	3.9	0.281999	0.000021	0.000945	0.281985	-27.8	0.8	-10.1	813
198	CAMPBELL-15YP09-138	18.2	2.2	0.282416	0.000036	0.001094	0.282415	-13.0	1.3	-11.3	81
199	CAMPBELL-15YP09-142	13.0	3.6	0.282787	0.000024	0.000998	0.282777	0.1	0.9	11.8	539
200	CAMPBELL-15YP09-144	8.3	2.5	0.282429	0.000031	0.000520	0.282423	-12.6	1.1	0.7	606
201	CAMPBELL-15YP09-148	26.6	1.8	0.282273	0.000042	0.001542	0.282240	-18.1	1.5	6.1	1132
202	CAMPBELL-15YP09-149	35.3	3.7	0.282602	0.000024	0.002119	0.282599	-6.5	0.8	-4.7	83
203	CAMPBELL-15YP09-150	15.3	3.2	0.282586	0.000023	0.000982	0.282584	-7.0	0.8	-5.3	80

Table 5: 15G002; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	(^{176}Yb + ^{176}Lu) / ^{176}Hf (%)	Volts Hf	^{176}Hf/^{177}Hf	± (1s)	^{176}Lu/^{177}Hf	^{176}Hf/^{177}Hf (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
204	CAMPBELL-15G002-006	16.8	2.5	0.282369	0.000023	0.000993	0.282362	-14.7	0.8	-6.2	394
206	CAMPBELL-15G002-012	19.5	2.6	0.282398	0.000024	0.001136	0.282391	-13.7	0.9	-6.9	317
207	CAMPBELL-15G002-013	18.4	2.8	0.282834	0.000026	0.001182	0.282832	1.7	0.9	3.5	81
208	CAMPBELL-15G002-015	25.1	2.6	0.281876	0.000024	0.001576	0.281847	-32.1	0.9	-11.2	981
209	CAMPBELL-15G002-017	11.7	2.6	0.281230	0.000023	0.000681	0.281206	-55.0	0.8	-13.6	1872
210	CAMPBELL-15G002-018	25.5	2.5	0.282639	0.000026	0.001458	0.282632	-5.2	0.9	0.3	257
211	CAMPBELL-15G002-020	18.1	2.7	0.282765	0.000028	0.001248	0.282764	-0.7	1.0	1.0	79
212	CAMPBELL-15G002-021	11.2	3.2	0.282396	0.000019	0.000729	0.282392	-13.8	0.7	-7.3	298
213	CAMPBELL-15G002-024	22.2	2.9	0.282649	0.000021	0.001495	0.282647	-4.8	0.7	-3.0	83
214	CAMPBELL-15G002-025	15.4	2.7	0.282465	0.000020	0.000872	0.282459	-11.3	0.7	-4.6	312
215	CAMPBELL-15G002-026	9.4	3.1	0.282404	0.000020	0.000645	0.282400	-13.5	0.7	-6.4	325
217	CAMPBELL-15G002-035	15.5	1.9	0.281544	0.000037	0.001121	0.281493	-43.9	1.3	8.3	2377
218	CAMPBELL-15G002-042	8.8	3.1	0.282095	0.000018	0.000578	0.282088	-24.4	0.6	-11.3	598
219	CAMPBELL-15G002-043	16.1	2.3	0.282401	0.000035	0.001096	0.282394	-13.6	1.2	-6.3	336
220	CAMPBELL-15G002-047	18.4	2.0	0.282525	0.000022	0.001185	0.282508	-9.2	0.8	7.9	794
221	CAMPBELL-15G002-048	40.5	3.1	0.282349	0.000026	0.002107	0.282258	-15.4	0.9	32.9	2268
222	CAMPBELL-15G002-055	11.7	2.9	0.282732	0.000025	0.000747	0.282731	-1.9	0.9	-0.3	74
223	CAMPBELL-15G002-057	9.3	3.0	0.282357	0.000027	0.000588	0.282353	-15.1	1.0	-8.4	307
224	CAMPBELL-15G002-058	24.2	2.8	0.282449	0.000026	0.001499	0.282439	-11.9	0.9	-3.7	384
225	CAMPBELL-15G002-060	21.2	3.0	0.281873	0.000029	0.001365	0.281859	-32.2	1.0	-20.2	565
226	CAMPBELL-15G002-061	18.2	3.7	0.281427	0.000021	0.001110	0.281418	-48.0	0.8	-38.7	436
228	CAMPBELL-15G002-071	16.6	2.9	0.282072	0.000021	0.000991	0.282059	-25.2	0.7	-10.8	666
229	CAMPBELL-15G002-075	20.5	2.8	0.282718	0.000030	0.001384	0.282716	-2.4	1.1	-0.7	77
230	CAMPBELL-15G002-079	11.5	2.9	0.282542	0.000022	0.000761	0.282537	-8.6	0.8	-1.6	321
231	CAMPBELL-15G002-081	26.6	2.6	0.282693	0.000021	0.001573	0.282686	-3.3	0.8	1.6	230
232	CAMPBELL-15G002-084	30.2	3.1	0.282843	0.000019	0.002403	0.282832	2.1	0.7	7.5	264
233	CAMPBELL-15G002-089	22.4	3.1	0.282776	0.000025	0.001504	0.282774	-0.3	0.9	1.3	75
235	CAMPBELL-15G002-094	57.7	2.1	0.282755	0.000025	0.003989	0.282749	-1.1	0.9	0.5	79
236	CAMPBELL-15G002-096	21.3	2.7	0.282545	0.000021	0.001304	0.282536	-8.5	0.7	0.0	397
237	CAMPBELL-15G002-098	19.1	2.7	0.282527	0.000028	0.001294	0.282520	-9.1	1.0	-2.5	309
239	CAMPBELL-15G002-103	23.9	2.7	0.282757	0.000021	0.001579	0.282754	-1.0	0.8	0.7	82
240	CAMPBELL-15G002-106	13.7	2.9	0.282644	0.000026	0.000871	0.282641	-5.0	0.9	-0.4	213
241	CAMPBELL-15G002-109	31.9	2.6	0.282674	0.000030	0.002120	0.282645	-3.9	1.1	11.3	725
242	CAMPBELL-15G002-112	17.1	2.7	0.282423	0.000022	0.001000	0.282416	-12.8	0.8	-3.9	410
243	CAMPBELL-15G002-113	16.3	2.8	0.282717	0.000032	0.001052	0.282715	-2.4	1.1	-0.6	83
244	CAMPBELL-15G002-118	17.9	2.2	0.282512	0.000030	0.001072	0.282507	-9.6	1.0	-3.5	284
245	CAMPBELL-15G002-120	39.4	3.2	0.282577	0.000021	0.002796	0.282573	-7.4	0.7	-5.7	82
247	CAMPBELL-15G002-123	28.4	2.2	0.282460	0.000025	0.002006	0.282448	-11.5	0.9	-4.9	318
248	CAMPBELL-15G002-124	14.4	2.4	0.282572	0.000030	0.000953	0.282567	-7.5	1.0	-0.3	334
249	CAMPBELL-15G002-127	44.0	2.1	0.282706	0.000030	0.002975	0.282702	-2.8	1.1	-1.3	75
250	CAMPBELL-15G002-130	19.0	2.7	0.282790	0.000017	0.001508	0.282788	0.2	0.6	1.8	77
251	CAMPBELL-15G002-132	9.9	2.7	0.282117	0.000024	0.000622	0.282106	-23.6	0.8	-1.7	998
252	CAMPBELL-15G002-129	27.2	3.2	0.282406	0.000020	0.001647	0.282397	-13.4	0.7	-6.9	308
253	CAMPBELL-15G002-135	20.8	1.7	0.281582	0.000029	0.001383	0.281556	-42.6	1.0	-21.2	997
254	CAMPBELL-15G002-136	23.7	2.0	0.282624	0.000027	0.001770	0.282621	-5.7	1.0	-4.0	79
255	CAMPBELL-15G002-142	1.5	2.0	0.282207	0.000022	0.000103	0.282206	-20.4	0.8	0.4	935
256	CAMPBELL-15G002-143	40.4	1.9	0.282593	0.000024	0.002499	0.282590	-6.8	0.9	-5.1	81

Table 6: 15G001; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	(^{176}Yb + ^{176}Lu) / ^{176}Hf (%)	Volts Hf	$^{176}Hf/^{177}Hf$	± (1s)	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$ (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
257	CAMPBELL-15G001-003	14.4	2.2	0.282877	0.000023	0.000954	0.282876	3.3	0.8	4.9	77
258	CAMPBELL-15G001-012	15.1	2.5	0.282890	0.000036	0.001006	0.282888	3.7	1.3	5.3	76
259	CAMPBELL-15G001-015	19.7	2.5	0.282872	0.000025	0.001330	0.282870	3.1	0.9	4.7	78
260	CAMPBELL-15G001-016	13.3	2.4	0.282904	0.000031	0.000938	0.282903	4.2	1.1	5.9	80
261	CAMPBELL-15G001-021	14.9	2.5	0.282880	0.000029	0.001042	0.282878	3.4	1.0	5.0	78
262	CAMPBELL-15G001-028	13.0	2.5	0.282889	0.000021	0.000873	0.282887	3.7	0.7	5.3	76
263	CAMPBELL-15G001-034	35.0	2.1	0.282878	0.000025	0.002118	0.282876	3.3	0.9	4.9	75
264	CAMPBELL-15G001-039	24.5	1.9	0.282912	0.000024	0.001577	0.282910	4.5	0.8	6.2	79
265	CAMPBELL-15G001-051	15.6	2.2	0.282937	0.000027	0.001007	0.282936	5.4	0.9	7.1	80
267	CAMPBELL-15G001-064	23.2	2.2	0.282874	0.000025	0.001599	0.282872	3.1	0.9	4.8	80
268	CAMPBELL-15G001-063	23.0	2.1	0.282813	0.000023	0.001597	0.282811	1.0	0.8	2.6	75
269	CAMPBELL-15G001-072	25.1	2.0	0.282838	0.000030	0.001728	0.282835	1.9	1.0	3.5	78
270	CAMPBELL-15G001-077	13.9	2.3	0.282826	0.000020	0.000977	0.282824	1.4	0.7	3.2	82
271	CAMPBELL-15G001-079	26.1	2.0	0.282811	0.000031	0.001825	0.282809	0.9	1.1	2.6	78
272	CAMPBELL-15G001-080	20.9	2.0	0.282857	0.000028	0.001391	0.282855	2.6	1.0	4.2	77
273	CAMPBELL-15G001-089	15.7	2.2	0.282852	0.000024	0.001048	0.282851	2.4	0.8	4.0	75
274	CAMPBELL-15G001-091	22.5	2.0	0.282752	0.000026	0.001492	0.282750	-1.2	0.9	0.5	79
275	CAMPBELL-15G001-095	21.1	2.5	0.282829	0.000030	0.001356	0.282827	1.6	1.1	3.2	76

Table 7:15YP08; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	(^{176}Yb + ^{176}Lu) / ^{176}Hf (%)	Volts Hf	^{176}Hf/^{177}Hf	± (1s)	^{176}Lu/^{177}Hf	^{176}Hf/^{177}Hf (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
276	CAMPBELL-15YP08-002	4.0	3.0	0.282231	0.000026	0.000245	0.282228	-19.6	0.9	-5.9	619
277	CAMPBELL-15YP08-004	19.0	3.1	0.282000	0.000026	0.001396	0.281973	-27.8	0.9	-6.0	1017
278	CAMPBELL-15YP08-005	11.5	3.6	0.282214	0.000025	0.000698	0.282206	-20.2	0.9	-6.3	637
279	CAMPBELL-15YP08-011	12.3	3.5	0.281778	0.000027	0.000789	0.281764	-35.6	0.9	-14.4	972
281	CAMPBELL-15YP08-013	13.4	3.4	0.282122	0.000028	0.000817	0.282108	-23.5	1.0	-3.8	900
282	CAMPBELL-15YP08-016	18.6	3.4	0.281177	0.000024	0.001254	0.281115	-56.9	0.8	-0.7	2569
283	CAMPBELL-15YP08-018	9.7	2.9	0.281975	0.000024	0.000609	0.281963	-28.6	0.8	-5.7	1044
284	CAMPBELL-15YP08-020	13.6	1.8	0.282481	0.000026	0.000963	0.282463	-10.8	0.9	11.4	1016
285	CAMPBELL-15YP08-021	10.1	3.9	0.281902	0.000020	0.000635	0.281890	-31.2	0.7	-8.4	1039
286	CAMPBELL-15YP08-026	9.8	2.3	0.282600	0.000028	0.000704	0.282591	-6.6	1.0	8.7	698
287	CAMPBELL-15YP08-029	5.9	3.6	0.281375	0.000025	0.000380	0.281361	-49.8	0.9	-5.9	1970
288	CAMPBELL-15YP08-031	13.9	3.2	0.282227	0.000024	0.000832	0.282215	-19.7	0.8	-1.9	817
289	CAMPBELL-15YP08-036	16.1	3.6	0.282426	0.000026	0.001131	0.282419	-12.7	0.9	-5.5	333
290	CAMPBELL-15YP08-037	14.7	2.4	0.282303	0.000027	0.001010	0.282291	-17.1	1.0	-3.8	611
291	CAMPBELL-15YP08-038	11.8	3.9	0.282327	0.000026	0.000698	0.282317	-16.2	0.9	0.0	739
292	CAMPBELL-15YP08-039	15.2	2.2	0.281947	0.000032	0.000901	0.281931	-29.6	1.1	-8.7	959
293	CAMPBELL-15YP08-040	7.5	2.0	0.282084	0.000029	0.000468	0.282076	-24.8	1.0	-4.9	904
294	CAMPBELL-15YP08-042	16.0	3.3	0.282501	0.000034	0.000953	0.282495	-10.0	1.2	-2.8	336
295	CAMPBELL-15YP08-043	4.5	3.0	0.282618	0.000033	0.000268	0.282615	-5.9	1.2	7.2	593
296	CAMPBELL-15YP08-044	11.0	1.5	0.282416	0.000034	0.000917	0.282402	-13.1	1.2	4.5	807
297	CAMPBELL-15YP08-046	21.1	4.2	0.281435	0.000034	0.001262	0.281386	-47.7	1.2	-3.7	2024
298	CAMPBELL-15YP08-049	17.5	2.4	0.281018	0.000032	0.000775	0.281014	-62.5	1.1	-55.9	305
299	CAMPBELL-15YP08-053	10.6	3.7	0.281965	0.000031	0.000697	0.281951	-29.0	1.1	-6.4	1032
300	CAMPBELL-15YP08-054	9.5	3.4	0.281911	0.000031	0.000626	0.281899	-30.9	1.1	-8.6	1016
301	CAMPBELL-15YP08-058	6.7	3.4	0.282133	0.000022	0.000413	0.282128	-23.0	0.8	-8.6	657
302	CAMPBELL-15YP08-059	7.4	3.4	0.282151	0.000025	0.000449	0.282146	-22.4	0.9	-8.6	630
303	CAMPBELL-15YP08-060	17.5	3.6	0.282627	0.000024	0.001055	0.282615	-5.6	0.8	8.0	627
304	CAMPBELL-15YP08-061	3.5	3.2	0.282835	0.000028	0.000279	0.282833	1.8	1.0	9.8	361
305	CAMPBELL-15YP08-64	49.1	2.0	0.282585	0.000034	0.003299	0.282568	-7.1	1.2	-1.5	275
306	CAMPBELL-15YP08-065	30.7	3.1	0.282468	0.000031	0.001774	0.282453	-11.2	1.1	-2.0	439
307	CAMPBELL-15YP08-066	12.7	3.2	0.281452	0.000022	0.000853	0.281421	-47.1	0.8	-5.3	1902
308	CAMPBELL-15YP08-070	16.3	2.1	0.282435	0.000033	0.001017	0.282427	-12.4	1.2	-2.8	443
309	CAMPBELL-15YP08-072	7.7	1.8	0.282092	0.000028	0.000513	0.282082	-24.5	1.0	-1.8	1028
310	CAMPBELL-15YP08-077	14.6	2.6	0.282610	0.000025	0.001241	0.282603	-6.2	0.9	1.0	336
311	CAMPBELL-15YP08-082	30.8	3.7	0.282453	0.000033	0.001738	0.282439	-11.7	1.2	-2.1	456
312	CAMPBELL-15YP08-089	12.6	2.4	0.282124	0.000027	0.000697	0.282116	-23.4	1.0	-9.9	616
313	CAMPBELL-15YP08-091	22.3	3.1	0.282544	0.000025	0.001584	0.282537	-8.5	0.9	-3.4	242
314	CAMPBELL-15YP08-098	14.7	1.4	0.282473	0.000039	0.001051	0.282460	-11.0	1.4	2.8	639
315	CAMPBELL-15YP08-101	6.6	3.0	0.282153	0.000025	0.000371	0.282149	-22.3	0.9	-9.0	605
316	CAMPBELL-15YP08-103	16.3	1.7	0.282188	0.000031	0.001145	0.282166	-21.1	1.1	0.8	1011
317	CAMPBELL-15YP08-109	25.7	2.8	0.282566	0.000033	0.001818	0.282548	-7.8	1.2	3.3	525
318	CAMPBELL-15YP08-114	14.1	3.1	0.282244	0.000032	0.000821	0.282235	-19.1	1.1	-6.1	600
319	CAMPBELL-15YP08-115	18.7	2.9	0.281633	0.000024	0.001254	0.281608	-40.7	0.8	-18.1	1053
320	CAMPBELL-15YP08-150	20.8	2.0	0.281383	0.000028	0.001177	0.281339	-49.6	1.0	-6.1	1994
321	CAMPBELL-15YP08-146	21.6	3.0	0.282223	0.000021	0.001139	0.282211	-19.9	0.8	-7.2	588
322	CAMPBELL-15YP08-145	21.8	2.7	0.282448	0.000030	0.001256	0.282438	-11.9	1.0	-2.3	450
323	CAMPBELL-15YP08-144	4.8	3.5	0.282069	0.000028	0.000341	0.282064	-25.3	1.0	-9.1	736

Table 7: 15YP12; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	$(^{176}Yb + ^{176}Lu) / ^{176}Hf$ (%)	Volts Hf	$^{176}Hf/^{177}Hf$	± (1s)	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$ (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
324	CAMPBELL-15YP12-002	32.6	2.2	0.282383	0.000031	0.002613	0.282367	-14.2	1.1	-7.5	328
325	CAMPBELL-15YP12-004	22.1	2.6	0.282387	0.000028	0.001424	0.282379	-14.1	1.0	-7.4	313
326	CAMPBELL-15YP12-011	14.2	3.0	0.282398	0.000028	0.001699	0.282388	-13.7	1.0	-7.0	319
327	CAMPBELL-15YP12-012	27.6	3.5	0.281205	0.000030	0.001677	0.281124	-55.9	1.1	-1.7	2512
328	CAMPBELL-15YP12-013	13.2	2.2	0.281774	0.000041	0.000822	0.281748	-35.7	1.5	1.4	1691
329	CAMPBELL-15YP12-014	37.6	3.3	0.282500	0.000030	0.002338	0.282486	-10.1	1.1	-3.4	321
330	CAMPBELL-15YP12-015	43.4	1.7	0.282525	0.000040	0.003187	0.282506	-9.2	1.4	-2.7	320
331	CAMPBELL-15YP12-023	42.6	3.4	0.282410	0.000025	0.002377	0.282396	-13.2	0.9	-6.7	319
332	CAMPBELL-15YP12-028	20.5	1.3	0.282373	0.000034	0.001870	0.282360	-14.6	1.2	-7.0	361
333	CAMPBELL-15YP12-029	38.4	1.6	0.282411	0.000044	0.002979	0.282391	-13.2	1.5	-6.1	354
334	CAMPBELL-15YP12-034	12.6	4.3	0.282567	0.000026	0.000871	0.282562	-7.7	0.9	-0.7	324
335	CAMPBELL-15YP12-035	19.5	3.8	0.282362	0.000026	0.001638	0.282336	-15.0	0.9	2.9	839
336	CAMPBELL-15YP12-037	21.1	3.3	0.282281	0.000022	0.001149	0.282274	-17.8	0.8	-10.6	337
337	CAMPBELL-15YP12-043	19.2	2.2	0.282405	0.000045	0.001519	0.282395	-13.4	1.6	-6.5	329
338	CAMPBELL-15YP12-046	14.4	2.2	0.282283	0.000025	0.001062	0.282272	-17.7	0.9	-5.4	570
339	CAMPBELL-15YP12-047	22.6	3.5	0.282393	0.000028	0.001445	0.282384	-13.9	1.0	-6.9	329
340	CAMPBELL-15YP12-070	25.8	2.5	0.282450	0.000033	0.001322	0.282442	-11.9	1.2	-5.1	314
341	CAMPBELL-15YP12-068	22.9	2.0	0.282467	0.000042	0.001445	0.282459	-11.2	1.5	-4.4	320
342	CAMPBELL-15YP12-067	11.9	2.3	0.282444	0.000028	0.000735	0.282437	-12.1	1.0	-1.5	483
343	CAMPBELL-15YP12-066	20.2	2.3	0.282324	0.000037	0.001190	0.282316	-16.3	1.3	-9.1	338
344	CAMPBELL-15YP12-062	32.4	1.9	0.282490	0.000042	0.002351	0.282476	-10.4	1.5	-3.7	325
345	CAMPBELL-15YP12-059	12.5	1.9	0.282221	0.000034	0.000811	0.282212	-19.9	1.2	-6.8	602

Table 8: 15YP13; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	(^{176}Yb + ^{176}Lu) / ^{176}Hf (%)	Volts Hf	^{176}Hf/^{177}Hf	± (1s)	^{176}Lu/^{177}Hf	^{176}Hf/^{177}Hf (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
346	CAMPBELL-15YP13-003	19.8	3.4	0.282596	0.000025	0.001365	0.282594	-6.7	0.9	-5.0	82
347	CAMPBELL-15YP13-004	35.4	2.7	0.282770	0.000031	0.002323	0.282767	-0.5	1.1	1.1	81
348	CAMPBELL-15YP13-127	39.4	2.9	0.282629	0.000034	0.002389	0.282625	-5.5	1.2	-3.7	85
349	CAMPBELL-15YP13-005	22.7	2.2	0.282697	0.000035	0.001611	0.282695	-3.1	1.2	-1.4	81
350	CAMPBELL-15YP13-006	12.3	2.2	0.282795	0.000037	0.000716	0.282794	0.4	1.3	2.1	78
351	CAMPBELL-15YP13-008	10.8	4.6	0.282435	0.000023	0.000640	0.282425	-12.4	0.8	5.7	825
352	CAMPBELL-15YP13-009	29.6	2.0	0.282769	0.000034	0.001929	0.282766	-0.6	1.2	1.1	81
353	CAMPBELL-15YP13-011	14.7	2.1	0.282360	0.000035	0.000969	0.282353	-15.0	1.2	-6.6	389
354	CAMPBELL-15YP13-013	53.9	2.4	0.282629	0.000035	0.003811	0.282624	-5.5	1.2	-3.9	81
355	CAMPBELL-15YP13-014	26.4	3.2	0.282672	0.000028	0.001935	0.282669	-4.0	1.0	-2.6	66
356	CAMPBELL-15YP13-022	15.7	3.9	0.282658	0.000023	0.001068	0.282656	-4.5	0.8	-2.7	82
357	CAMPBELL-15YP13-026	43.4	2.6	0.282725	0.000030	0.002646	0.282721	-2.1	1.1	-0.4	83
358	CAMPBELL-15YP13-027	25.9	3.1	0.282650	0.000020	0.001712	0.282648	-4.8	0.7	-3.1	80
359	CAMPBELL-15YP13-029	9.3	3.0	0.281964	0.000032	0.000671	0.281952	-29.0	1.1	-8.2	950
360	CAMPBELL-15YP13-032	25.6	2.6	0.282425	0.000026	0.001667	0.282416	-12.7	0.9	-6.4	299
361	CAMPBELL-15YP13-033	9.7	3.4	0.282772	0.000023	0.000660	0.282767	-0.5	0.8	7.8	380
362	CAMPBELL-15YP13-034	11.2	3.4	0.282696	0.000033	0.001230	0.282694	-3.2	1.2	-1.4	82
363	CAMPBELL-15YP13-037	18.7	3.3	0.282673	0.000022	0.001381	0.282671	-4.0	0.8	-2.2	83
364	CAMPBELL-15YP13-039	17.1	4.5	0.282318	0.000021	0.000773	0.282311	-16.5	0.7	-5.8	492
365	CAMPBELL-15YP13-042	27.2	3.3	0.282680	0.000028	0.002843	0.282676	-3.7	1.0	-2.1	81
366	CAMPBELL-15YP13-046	14.8	3.0	0.282880	0.000025	0.000984	0.282878	3.3	0.9	5.6	105
367	CAMPBELL-15YP13-047	10.6	3.5	0.282936	0.000021	0.000749	0.282935	5.3	0.7	7.7	108
368	CAMPBELL-15YP13-048	13.0	3.7	0.282593	0.000022	0.000966	0.282588	-6.8	0.8	-0.8	276
369	CAMPBELL-15YP13-054	32.2	3.1	0.282735	0.000038	0.002624	0.282731	-1.8	1.4	-0.1	83
370	CAMPBELL-15YP13-055	23.0	3.5	0.282728	0.000034	0.001557	0.282726	-2.0	1.2	-0.3	80
371	CAMPBELL-15YP13-059	25.0	3.0	0.282656	0.000029	0.001762	0.282653	-4.6	1.0	-2.8	84
372	CAMPBELL-15YP13-061	20.6	3.4	0.282707	0.000029	0.002135	0.282704	-2.8	1.0	-1.1	79
373	CAMPBELL-15YP13-062	21.8	3.0	0.282711	0.000023	0.001709	0.282708	-2.6	0.8	-0.9	82
374	CAMPBELL-15YP13-072	16.7	4.1	0.282628	0.000027	0.001089	0.282627	-5.5	0.9	-3.8	80
375	CAMPBELL-15YP13-074	21.7	2.9	0.282951	0.000022	0.001709	0.282948	5.9	0.8	8.3	113
376	CAMPBELL-15YP13-078	23.6	3.1	0.282674	0.000038	0.001689	0.282671	-3.9	1.3	-2.2	81
377	CAMPBELL-15YP13-080	7.9	2.4	0.282342	0.000034	0.000584	0.282335	-15.7	1.2	-1.8	631
378	CAMPBELL-15YP13-088	20.0	2.1	0.282823	0.000029	0.001376	0.282821	1.3	1.0	3.1	81
379	CAMPBELL-15YP13-090	11.5	1.7	0.282563	0.000047	0.000964	0.282560	-7.9	1.7	-4.3	167
380	CAMPBELL-15YP13-094	48.8	3.3	0.282862	0.000035	0.002794	0.282858	2.7	1.2	4.3	78
382	CAMPBELL-15YP13-109	7.0	3.7	0.280952	0.000023	0.000418	0.280933	-64.8	0.8	-9.6	2464
383	CAMPBELL-15YP13-120	42.4	1.6	0.282836	0.000060	0.003595	0.282830	1.8	2.1	3.6	90
384	CAMPBELL-15YP13-124	30.9	1.8	0.282782	0.000037	0.002209	0.282778	-0.1	1.3	1.7	89
385	CAMPBELL-15YP13-125	17.4	3.7	0.282774	0.000022	0.001132	0.282771	-0.4	0.8	3.3	173
386	CAMPBELL-15YP13-126	68.5	2.6	0.282918	0.000040	0.004808	0.282899	4.7	1.4	8.7	211

Table 9: 15YP07; LA-MC-ICP-MS Zircon Hafnium Data

Order	Sample	(^{176}Yb + ^{176}Lu) / ^{176}Hf (%)	Volts Hf	^{176}Hf/^{177}Hf	± (1s)	^{176}Lu/^{177}Hf	^{176}Hf/^{177}Hf (T)	E-Hf (0)	E-Hf (0) ± (1s)	E-Hf (T)	Age (Ma)
387	CAMPBELL-15YP07-001	27.7	3.9	0.282959	0.000033	0.001976	0.282957	6.2	1.2	7.2	50
388	CAMPBELL-15YP07-003	34.5	3.2	0.282902	0.000044	0.002450	0.282900	4.1	1.6	5.2	52
389	CAMPBELL-15YP07-007	27.3	3.9	0.282904	0.000031	0.002103	0.282902	4.2	1.1	5.2	49
394	CAMPBELL-15YP07-018	32.9	3.7	0.282928	0.000041	0.002377	0.282926	5.1	1.5	6.0	46
395	CAMPBELL-15YP07-027	21.3	3.4	0.282897	0.000032	0.001510	0.282896	4.0	1.1	5.0	47
396	CAMPBELL-15YP07-029	23.7	3.7	0.282954	0.000026	0.001684	0.282953	6.0	0.9	7.0	48
397	CAMPBELL-15YP07-034	31.7	3.7	0.282954	0.000029	0.002308	0.282952	6.0	1.0	6.9	47
398	CAMPBELL-15YP07-035	27.4	3.8	0.282901	0.000033	0.002304	0.282899	4.1	1.2	5.1	50
399	CAMPBELL-15YP07-036	29.5	3.7	0.282918	0.000033	0.002151	0.282916	4.7	1.2	5.7	49
400	CAMPBELL-15YP07-044	32.9	3.8	0.282889	0.000029	0.002398	0.282887	3.7	1.0	4.6	46