

II-WORKSHOP OF INORGANIC MASS SPECTROMETRY – 2017

LA-MC-ICP-MS instrumentation and acquisition of U-Pb ages on zircon, monazite and titanite at CPGeo-USP

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Acquisition of U-Pb data on minerals is routinely performed in the Geochronology Research Center Laboratory (USP) by laser inductively coupled plasma multicollector mass spectrometry (LA-MC-ICP-MS) technique. The main application of these analytical data is on geochronology and rock petrogenetic problems, once the results can be applied to determine the age of crystallization of igneous rocks, the age of metamorphism and the age of inherited cores. Additionally, U-Pb ages can provide information on provenance and age of deposition of detrital zircons.

The U-Pb geochronology is based on the disintegration of the ²³⁵U (0,704Ga half-life) and ²³⁸U (4,47Ga half-life) isotopes into the ²⁰⁷Pb and ²⁰⁶Pb radiogenic isotopes, respectively.

The procedure consists of isolating the minerals from the rocks by conventional hydraulic, magnetic and density (heavy liquids) techniques, before the final purification by handpicking the minerals under stereomicroscope. The selected grains are then mounted on specific resin-made disks (“mount”) and polished. After these procedures, transmitted light and cathodoluminescence images are obtained in a stereomicroscope (Olympus SZH10® - Zoom Stereo Microscope System) and scanning electron microscope (VPESEM - Quanta 250 - FEI Company®) respectively to identify the internal structure of the grains used to orientate the Laser spot position.

The disk to be analyzed is placed in the sample chamber of the laser (Photon-machines® – Analyzer G2 – 193 nm – Excimer Laser Ablation System) where the He (6.0 purity) gas transport the material removed from the crystal through a Teflon tube into the MC-ICP-MS (Thermo® – Neptune), where the sample is ionized in the argon plasma (6000 to 10000K). The resulting ions are introduced into the mass spectrometer and separated by a high resolution magnetic sector analyzer as a function of its mass / charge ratio.

In the CPGeo, U-Pb radiometric system is applied on U-bearing minerals such as zircons, monazites and titanites. The operating conditions for analysis of this methodology in the laser are: 6Hz frequency, 9.98 J/cm² fluence, ablating during approximate a minute and 32 µm spot size to zircon and titanite, and 19 µm to monazite. The configuration of MC-ICP-MS is mixed between Faraday collectors and ion multipliers (MIC) and they are calibrated to analyze isotopes: ²³⁸U, ²⁰⁶Pb, ²⁰⁸Pb in Faradays and ²⁰⁷Pb and interferences in MIC. At each 50 minutes of analyses, are measured: four blanks, four synthetic NIST-612 standard and five GJ1 standard that they are used for all corrections, one of the Mud Tank standard that is analyzed as an unknown sample, and twelve measurements of unknown sample that complete one spreadsheet. The data obtained in the MC-ICP-MS are reduced and corrected with in-house software developed by Siqueira et al, 2014, using a R statistical package based on Python programming language. Graphs and ages results are reported using Isoplot 3.0 (Ludwig, 2003) software.

Three results of zircon (figure 1), monazite (figure 2) and titanite (figure 3) standards are reported below. These results when compared with the TIMS available values in the international literature: $608.5 \pm 0.4\text{Ma}$ (Jackson et al., 2004); $424.9 \pm 0.4\text{Ma}$ (Aleinikoff et al., 2006) and $1047.1 \pm 0.4\text{Ma}$ (Aleinikoff et al., 2007), respectively, illustrated the quality of LA-ICP-MS analysis performed at USP laboratory.

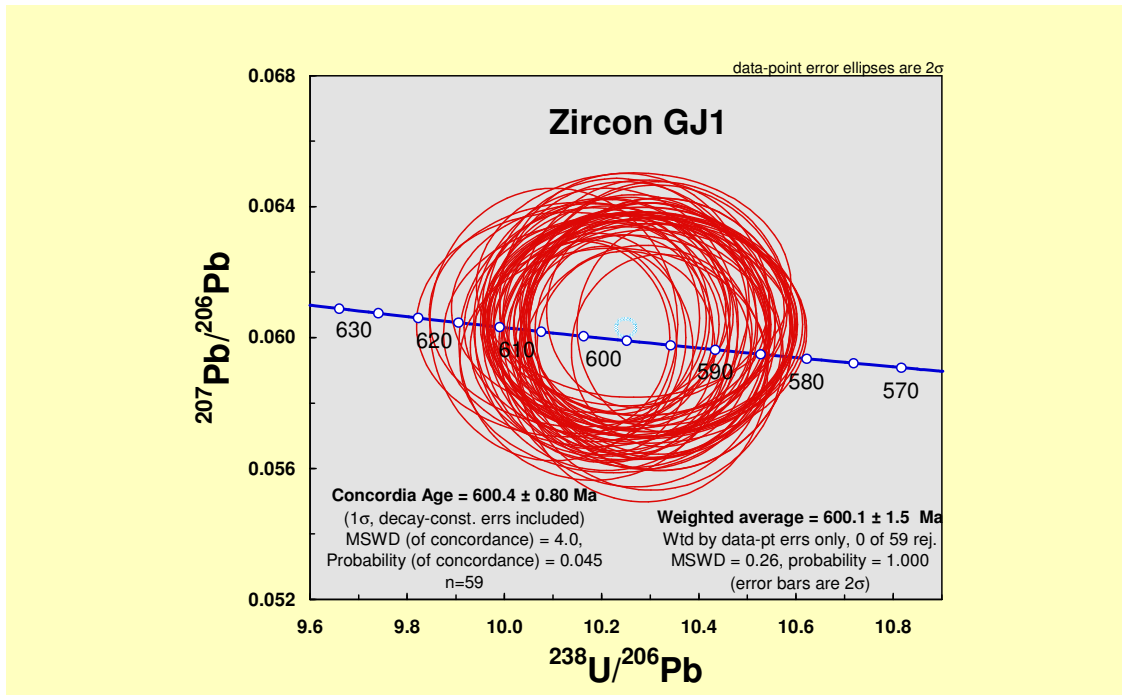


Figure 1: Tera-Wasserburg plot GJ1 zircon standard.

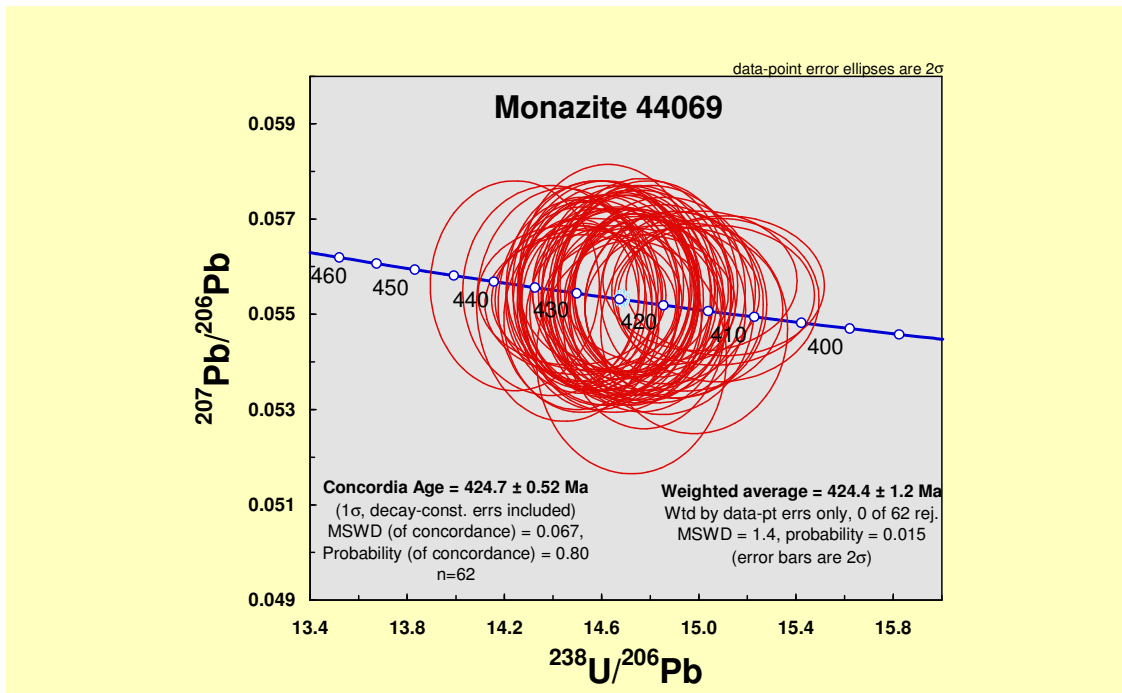


Figure 2: Tera-Wasserburg plot 44069 monazite standard.

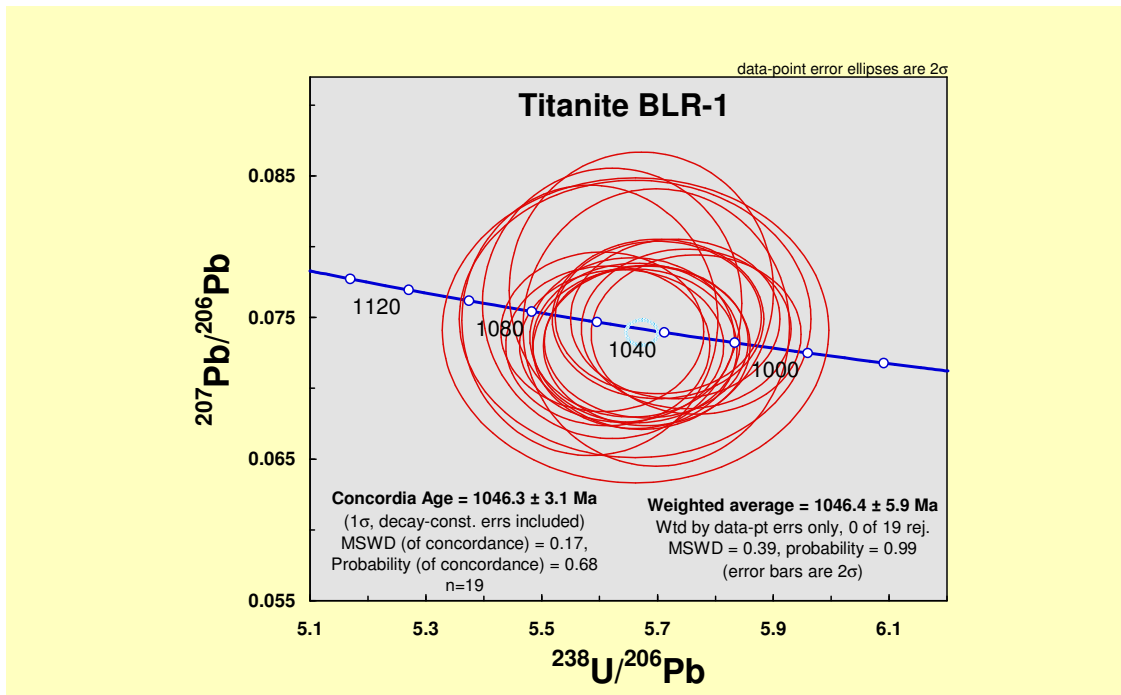


Figure 3: Tera-Wasserburg plot BLR1 titanite standard

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