Optimization of LA-ICP-MS for U-Pb dating of young zircons

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Laser ablation ICP-MS is a powerful method to determine the age of rocks by measuring U/Th/Pb isotopes. The method is fast, cheap and for many applications precise and accurate enough when using robust corrections and reference materials [1]. In this work we show the optimization of a laser ablation system equipped with a 2nd generation 2 volume constant geometry ablation cell (Resonetics: S-155LR) in combination with a high sensitivity sector filed ICP-MS (Thermo: Element XR). Investigated parameters includes laser crater size, repetition rate and energy density, as well as signal length, gas flows and ICP-MS parameters with respect to, precision, accuracy, sample throughput and resolution. Results for different zircon standard reference material are shown and observations including down hole fractionation, low count rates, and the importance of integration interval settings are discussed.

The optimized instrumentation is used to determine the age of young zircons from Kos Plateau Tuff with a known eruption age of 160 ky. Due to the high sensitivity, it is possible to date these zircons using a 30 μm spot and 5Hz ablation rate with a precision similar to SHRIMP [2]. Several challenges dating zircons of this age range are addressed: Due to the low count rates on the Pb isotopes the mean of ratios is different than the ratio of the mean. For accurate dating of young zircons a U-Th disequilibrium correction is necessary, for which a precise Th/U ratio is needed, both in the individual zircons as well as in the magma. Due to the relatively fast drilling of laser ablation (~0.1 μm/pulse) we often observe inherited cores resulting in mixed signals which makes the setting of integration intervals important but can give indication about the pre-eruptive magmatic history of zircons [3].

[1] Paton *et al*. (2010) *Geochem. Geophys. Geosyst.* **11**, 1525-2027. [2] Bachmann *et al*. (2007) *Geology* **35**, 73-76. [3] Simon *et al*. (2008) *EPSL* **266**, 182-194.

On the filtering of dust by planetesimals and its consequences for the compositions of planetary systems

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The inner solar system, and in particular Mercury, Venus, the Earth and Mars contains very little water. Asteroids between Mars and Jupiter are known to be progressively more water-rich as they orbit further to the Sun. Yet, we know that protoplanetary disks contain vast amounts of water ice, and that the ice line (i.e. the distance at which water vaporizes) moves progressively inside of 1 AU before gas photoevaporation takes place. Ice grains could thus potentially deliver significant amounts of water there, in disagreement with the evidence in our Solar System.

We show that the inside-out formation of planetesimals can effectively filter dust and prevent icy grains from reaching the inner regions of the system. This occurs when the mass in planetesimals exceeds a threshold well below that obtained from adding the mass of solids present in the present-day Solar System. This thus explains why the inner Solar System is dry, but potentially also why other planetary systems may lead to the formation of wet, low-density planets. The potentially high solid-to-gas ratio obtained in the late phases would also help to understand the very large masses in heavy elements derived in giant planets observed by transit surveys including CoRoT and Kepler.

www.minersoc.org
DOI:10.1180/minmag.2013.077.5.7