A new method for analysing thin (≥2μm) zircon rims by LA-ICP-MS

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Low temperature crustal melt granites (e.g. High Himalayan leucogranites) are often saturated in zirconium leading to the widespread prevalence of zircon crystals with inherited cores surrounded by very thin (often <10μm) and irregular magmatic rims. In these zircons only the igneous rims record the true crystallisation age of the leucogranite.

Current *in situ* SIMS and ICP-MS zircon U-Pb analytical techniques generally employ static 'spot' analysis, such that it is difficult to position a spot so that only rim material is analysed. This in turn makes accurate and precise age determination of thin (<20μm) rim domains particularly difficult.

In order to overcome this issue, we have developed a novel yet relatively simple analytical strategy that involves mounting whole crystals (with thin rims intact) on double-sided sticky tape and analysing them by LA-MC-ICP-MS. This presents the laser with a flat outer surface of the grain that thin rims can be ablated using dynamic 'line' (See Fig. 1) or 'box' rasters. With this method external growth zones as thin as 2μm can be confidently analysed without sampling deeper core material. Application of this technique to 'standard' zircons shows little, if any, degradation in overall data quality compared to conventional static spot analysis.

This method is being further modified in an attempt to produce both trace element and U-Th-Pb isotopic depth profiles in zircon and other accessory phases. By matching the laser pulse rate to the isotopic integration rate and taking advantage of a short (<0.5s) transfer time of material from ablation cell to mass spectrometer (via a low volume ablation cell) a rapid depth profile can be generated similar to that currently generated by SIMS methods.

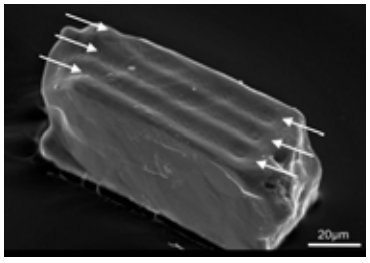

Figure 1: ~2μm deep ablations (arrowed) on the surface of a 150μm long zircon.

Obtaining $D_{Ni}^{met/sil}$ in the LHDAC

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The use of Laser-Heated Diamond Anvil Cell (LHDAC) for element partitioning will extend the reach of experimental petrology to unprecedented pressures, but only if LHDAC techniques can be shown to yield accurate partition coefficients. We present Ni partitioning experiments between liquid metal and liquid silicate from 16 and 60 GPa and 2700-5450K. Our goal is to develop techniques that reproduce accepted partitioning values in the multi-anvil pressure range and to develop tests for equilibrium at all pressures.

We prepared glasses in the Fe-Mg-Ca-Si-Al-O± Ni system and mechanically mixed them at fine scale with Fe ± Ni metal powder to create two starting aggregates, each approaching equilibrium from a different direction (Ni → NiO and NiO → Ni), to create a pair of "reversals." Samples were embedded in MgO and heated to the target temperature for 30sec-5min using the new diode-pumped double-side fiber laser system at APS station 13-IDD. Superliquidus conditions were ensured using XRD.

We analyzed the polished samples with Smithsonian's nanoSEM (EDS) and by microprobe (WDS). Analyses on Carnegie's NanoSIMS 50L ion probe are underway. We estimate oxygen fugacity relative to the iron-wüstite buffer as ΔIW=2log(XFeO-gl/XFe-alloy). Experiments range from IW to IW-1. lnD(Ni) from both "normal" and "reversal" experiments are consistent with those predicted by the regression of [1], with the exception of our highest pressure experiment for which we obtained a more siderophile value.

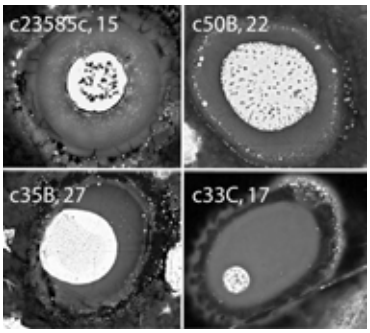

Figure 1: Samples quenched to immiscible pools of glass and FeNi alloy. Labels on BSE images: expt #, field of view (μm).

[1] Chabot *et al*. (2005) *GCA* **69**, 2141–2151.