Trace element partitioning between iron-titanium oxides and silicate melts with implications for the early differentiation of the moon

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Mineral/melt trace element partition coefficients for a large number of trace elements (Zr, Hf, Ta, Nb, V, Co, Cu, Zn, Sr, REE, Sb, Sn, Mo, Cr, W, U, Th) were determined experimentally (1150-1250°C, 1 atm≤P≥1 GPa) for ilmenite ($FeTiO_3$), ulvöspinel (Fe_2TiO_4), and minerals of the armalcolite solid solution $(Fe,Mg)Ti_2O_5$). Both crystals and melts were analysed using electron microprobe and Laser ablation ICPMS. The measured partition coefficients indicate that the high field strength elements (Zr, Hf, Nb, and Ta) and some transition metals (V, Cr, Co, Sn) are moderately compatible in iron-titanium oxides, whereas other elements (REE, Y, Sr, U, Th, Mo, Sb, and W) are strongly incompatible. The partition coefficients for U are always significantly higher than the Th partition coefficients, which makes Fe-Ti oxides efficient in fractionating U from Th, very similar to rutile [1]. Our data also indicate that ilmenite, and other iron-titanium oxides, are able to fractionate W from Hf, the latter of which is much more compatible under reducing conditions. This makes the Fe-Ti oxides very effective agents to influence Hf-W isotopic ratios during the early evolution of a lunar magma ocean [e.g., 2]. In addition, we will also present some trace element partition coefficients for iron and titanium-bearing orthopyroxene.

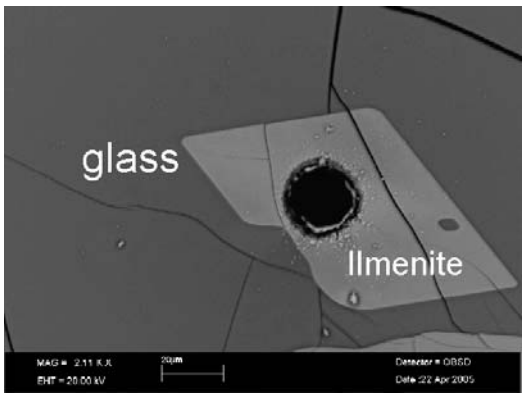

Fig 1.: Experimentally equilibrated ilmenite and silicate melt. Also shown are Laser ablation pits, about 20µm in diameter.

References

[1] Klemme S., et al. (2005) *GCA* **69**, 2361-2371.

[2] Lee, D.C. et al. (2002) *EPSL* **198**, 267-274.