## The solubility of Os and Ir in sulphide melts

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The concentration of Os into refractory, chemically inert, $\mu$m-sized Os-Ir alloys is significant for our understanding of the Os isotopic evolution of the terrestrial mantle and the preservation Os isotopic heterogeneities in mantle rocks over several Gy. However, despite this, not much is known about their origin. Some authors suggested desulfuration of the mantle or direct precipitation of metal as mechanisms responsible for the formation of Os-Ir alloys in the terrestrial mantle rocks.

We report the results of an experimental study on solubilities of Os and Ir in sulphide melts over a large range of $fO_2$, $fS_2$ at 1300$^o$C. Experiments were carried out in a vertical muffle tube furnace, equiped for gas mixing, with fO2 and fS2 controlled by mixing $SO_2$, CO and $CO_2$. Run products were analyzed by electron microprobe for major elements, and by LA-ICP-MS for trace elements.

The solubilities of Os and Ir in sulphide melts increase with increasing fS2, with Os dissolving as $Os^{2+}$ at high $fS_2$ and $Os^0$ at low $fS_2$; and Ir dissolving as $Ir^{4+}$ at high $fS_2$ and $Ir^0$ at low $fS_2$. The effect of $fO_2$ on the solubility of Ir and Os is negligible. Although Os and Ir solubilities in the sulphide melt increases with fS2, solubilities are low when compared to the solubilities of other HSE (e.g. Pt). The maximum Ir and Os solubilities obtained at $fS_2$=$10^{-1.6}$ and 1300$^o$C in a sulphide melt is ca.2000 ppm and ca.200 ppm respectively.

Assuming a relative $fO_2$ of QFM-1, and a $fS_2$ of $10^{-0.5}$ bars, the calculated $D_{Os}^{sul/sil}$ is ca.$10^6$ and $D_{Ir}^{sul/sil}$ is ca.$10^5$. The low solubilities of Ir and Os in sulphide melts, coupled with the high $D_i^{sul/sil}$, suggests that Os and Ir concentrate initially in the sulphide melt at $>$1200$^o$C. During partial melting of the mantle, the extraction of sulfides into silicate melt lead to a $fS_2$ decrease which likely triggers the exsolution of Or-Ir alloys from the refractory sulphide left in the residue. This mechanism is likely to be the most prevalent in the upper mantle of the Earth, with implications to the survival of Os heterogeneity of the terrestrial mantle.

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Abs. No. **499**
Meeting: **DMG 2008**
submitted by: **Fonseca, Raúl**
email: **raul.fonseca@uni-bonn.de**
date: **2008-06-02**
Req. presentation: **Vortrag**
Req. session: **S11**