# Synthetic melt inclusion and quartz-trap methods for determining Pt solubility in a mafic mineral

## Halide melt system at 750 degrees C, 400 bar

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# Synthetic melt inclusion and quartz-trap methods for determining Pt solubility in a mafic mineral – Halide melt system at 750°C, 400 bar

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The solubility of platinum in a hydrous salt melt (S-free; ~ 75 wt% $CaCl_2$+$MgCl_2$, 25 wt% $H_2O$) was investigated at conditions consistent with the post-cumulus metamorphism of layered intrusions that host platinum-group element deposits. The salt melts were reacted with metallic Pt or Pt-$PtAs_2$ (sperrylite) in Pt capsules using conventional Rene 41 cold seal vessels which buffer $fO_2$ at FMQ-1. The activities of relevant metal-complexing species (e.g., $HCl^0$) were buffered by the assemblage tremolite-diopside-enstatite-quartz. Salt melts were trapped (simultaneously) in the matrix of a quartz trap (granulated natural quartz partially isolated in a smaller gold capsule) and in synthetic melt inclusions trapped in pre-fractured quartz. After quenching, the melt inclusions and quartz trap material were analyzed by laser ablation ICP-MS.

Platinum solubility is in the low ppm range. Analysis of different portions of the quartz traps using a 90 μm pit size yielded relatively consistent platinum concentrations of 14.4 ± 6.7 ppm ($2\sigma$, n=6; Pt metal source), and 4.6 ppm ± 1.9 ppm ($2\sigma$, n=6; Pt-$PtAs_2$). Based on the consistency of the metal concentrations from different parts of the trap, it is considered that these concentrations are most representative of metal solubility at run conditions and that the laser sampling size sufficiently overcomes local heterogeneity in the distribution of Pt quench products. By contrast, Pt concentrations in hydrosaline melt inclusions from different areas of a 3 mm x 10 mm quartz cylinder range from below detection limits (~0.1 ppm) to 14.4 ppm (n=28; Pt) and to 6.6 ppm (n=31; Pt-$PtAs_2$). The range in observed metal concentrations in this trapping medium increases with the number of inclusions analyzed, and varies between different areas in the quartz cylinder. This confirms observations that saline inclusions trapped in pre-fractured quartz heal quickly (as early as several hours) at elevated temperatures, and may trap disequilibrium metal concentrations in mineral- or melt-buffered systems (Hanley *et al*., 2005); thus, they are suitable only for qualitative evaluation of trace metal solubility.

The data demonstrates that Pt is highly soluble at conditions consistent with post-cumulus metamorphic activity in layered intrusions, and that salt melts may significantly modify primary metal concentrations in layered intrusions and redistribute these metals. Additionally, Pt solubility in the hydrosaline melt was reduced by a factor of ~ 3 in the presence of a platinum arsenide phase.

## References

Hanley, J. J., Pettke, T., Mungall., J.E., and Spooner, E.T.C. (2005), *Geochim. Cosmochim. Acta* **69** 2593-2611.