Carbonyl as a possible carrier of platinum in magmatic fluids

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CO forms the most stable compounds with π bonding (stronger than C_2H_4, C_2H_2 and others) with native PGE and some cations including Au^+. We find experimentally that pressure of 50-200 MPa stabilizes platinum carbonyls to the magmatic temperatures of 800-950ºC [1]. We performed an experimental study of Pt solubility in CO-bearing fluids at 800-950°C and 0.5-2.0 kbar, using a double capsule technique for fluid generation by the thermal decomposition of MgC_2O_4, with the fluid trapped in porous welded silica glass and Al_2O_3 ceramics. Bulk Pt content was measured with electrothermal atomic absorption spectrometry (ETAAS) and LA-ICP-MS. We obtain the first estimates of solubility in CO-CO_2 fluid at fO_2 near CCO buffer that is no less than 600 ppm at P=200 MPa and T=950ºC. Using of albite glass as a trap allows capturing of the reactive fluid and dissolved carbonyls in the bubbles. Raman spectroscopy of quenching phases in the bubble formed at P=100 MPa and T=950ºC confirms formation of polynuclear carbonyl. Carbonyl of Pt absorbed on carbon was also identified. The pressure dependence of Pt solubility at 950°C between 0.5 and 2 kbar is consistent with the formation of $Pt3(CO)_6$ or $Pt3(CO)_6^{2-}$ (Chini complex) Raman spectroscopy data support this interpretation. LA-ICP-MS analysis demonstrated that iron is transferred by fluid along with Pt. Iron carbonyl is unstable at these PT conditions and neutral complex composed of Fe^{2+} and $Pt_3(CO)_6^{2-}$ can be responsible for the observed Fe transfer and formation of Pt_3Fe. Significant Pt solubility is expected at near solidus temperatures of the upper crustal (P=200-300 MPa) ultramafic-mafic intrusions hosting the largest PGE deposits. Solubility of Pt in the fluid at fO_2 near CCO buffer (graphitized rocks) is predicted to be strongly dependent on temperature and at P=500 MPa it will reach hundreds ppm level at the temperatures above 600-700ºC (amphibolite facies metamorphism).

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1. Simakin A.G., Salova T.P., Gabitov R.I., Isaenko S.I. (2016) Geofluids,16 , 1043-1067.