Distribution of Gold in Mantle Rocks

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The geochemical behaviour of Au has been studied extensively under crustal conditions with a strong emphasis on hydrothermal ore systems for their economic significance. Background Au concentrations in various crustal lithologies have been established for Au mobility models. Despite the fact that all the gold in the Earth's crust ultimately was sourced from the mantle, our knowledge of the content and distribution of Au in mantle rocks is minimal at best. To partially address this situation, this study focuses on mantle xenoliths from the Tubaf seamount in the Bismarck Archipelago, western Pacific Ocean. This location provides a unique opportunity to study mantle samples recently erupted (~3Ma) from beneath an area of young crust that hosts a world-class Au deposit (Lihir Island).

Gold and other highly siderophile elements (HSE: Re, Os, Ir, Ru, Rh, Pt, Pd, and Au) have been quantified using Laser-Ablation-Inductively-Coupled-Plasma-Mass-Spectrometry (LA-ICP-MS) in the mantle minerals that comprise the Tubaf seamount spinel-facies peridotites (olivine, cpx, opx, spinel, and sulfides). Measurements provide median Au concentrations in sulfides (41.5 ppb), cpx (0.77 ppb), opx (0.67 ppb), olivine (0.7 ppb), and spinel (1.275 ppb). All these phases have been fully quantified for Au and other PGEs in one samples so far, with sulphides in other samples being quantified too. Mass-balance calculations indicates that ~97% of all gold is hosted in silicates, with opx (58%) being the dominant host, followed by olivine (~33%). Only ~ 2.5% of gold is hosted in sulfide, and 0.2% in oxides for this sample. PGE patterns for the sulphides are enriched in Pt-group PGEs and depleted in Ir-group PGEs in the Tubaf peridotites, suggesting they are metasomatic in nature. A tentative conclusion from these findings is that even in rocks containing some metasomatic sulphide, silicates may dominate the Au budget. It is important to further understand whether Au is re-enriched in metasomatic silicates as well as sulphides, helping to understand how Au is mobilised in the mantle.

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