An experimental study of the solubility of gold in crude oil: implications for ore genesis

A.E.WILLIAMS-JONES AND A.A. MIGDISOV

Department of Earth &Planetary. Sciences, McGill University, Montreal, Canada; willyj@eps.mcgill.ca

Hydrocarbons occur with gold in several ore deposit types. For example, in the Witwatersrand basin, over 40% of gold production has come from carbon seams, which are now widely interpreted to represent migration paths of liquid hydrocarbons. Moreover, liquid hydrocarbons are preserved as fluid inclusions in overgrowths on detrital quartz grains in the siliciclastic rocks, suggesting that oil migration was an essential part of the early history of the basin. In Nevada, many of the Carlin gold deposits contain bitumen and in some cases liquid hydrocarbons. As in the Witwatersrand, there is commonly a close spatial association between the gold and the hydrocarbons, with both occupying the same structures. In some cases, there is even a demonstrable link between the gold deposits and producing oil fields. Where a genetic association between gold and hydrocarbons has been proposed, the role generally attributed to the hydrocarbons is in the deposition of the gold. However, it is attractive to speculate, as some others have done, that liquid hydrocarbons may also play a role in the transport of this metal.

In order to investigate the possibility that liquid hydrocarbons could constitute a gold-depositing ore fluid, we conducted experiments aimed at determining the solubility of gold in crude oil at temperatures of 150 and 200 °C. The experiments were performed in titanium autoclaves with the metal being introduced as gold wire. The autoclaves were heated in an IsoTemp Fisher oven for 3 to 5 days, depending on the temperature of the experiment. After equilibration, the autoclaves were quenched to room temperature and a sample of crude oil was collected for analysis. Gold precipitated on the walls of the autoclaves during quenching was dissolved by aqua regia after removal of the crude oil from the autoclave. Concentrations of gold in the oils and the washing solutions were determined using neutron activation analysis. Experiments were conducted on crude oil from two localities. Both oils dissolved similar concentrations of gold but, whereas one of the oils deposited most of its gold on quenching, a substantial proportion of the gold remained dissolved in the other oil. The solubility of gold in the crude oil averaged 9 ppm at 150 °C and 14 ppm at 200 °C

The results of these preliminary experiments show that liquid hydrocarbons are capable of transporting ore level and higher concentrations of gold. While this does not necessarily mean that they played this role in the deposits containing them, it leaves open this possibility and also the possibility that hydrocarbons could remobilize existing gold deposits.