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Tellurium in Gold Deposits: Linking Mineralizing Processes to Metallurgical Outcomes

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Tellurium is one of the rarest elements on Earth and very little is known about its role in ore forming processes or its deportment after ore processing. It is vital for advanced technology such as solar panels, thermoelectric devices, thermal infrared imaging, and is a prominent fixture in most jurisdictional critical mineral strategies globally. Although it is four times rarer than Au, some of the best opportunities for producing Te come from Au deposits.

From its residence in early pyrite to its deposition with native gold and Au-Ag tellurides, the genetic link between Te and Au is unequivocal. In addition, its strong affinity for magmatic processes makes the presence of significant Te an important indicator of magmatic input in orogenic deposits.

In this presentation, we highlight the life cycle of Te in the Au deposits of Ontario with a close examination of the ore-forming processes and metal deportment at the Macassa mine in Kirkland Lake. At Macassa, Te concentrations are up to six times higher than Au in ore, and the most common mineral hosts to Te are petzite, altaite, and calaverite. Tellurium concentrations going into tailings remain consistent at 25-30 ppm Te, and frohbergite is the dominant host mineral precipitating out of solution in the fine tails after processing.

Some magmatic input is required to account for the large amount of Te found at Macassa. The most likely processes to account for the high-grade native gold and intergrown tellurides that are paragenetically late in the ore deposition are transport by fluid-mediated, Te-rich melts during Au remobilization. Finally, the Macassa mine and other deposits of the Kirkland Lake camp (i.e., Toburn, Sylvanite, Wright-Hargreaves, Lake Shore, Teck Hughes, and Kirkland Minerals) represent one of the best options for Te byproduct potential in the province of Ontario and offer an opportunity for metallurgical innovation in Au ore processing.