Chapter 12

Coiled Tubing Drilling and Real-Time Sensing—Enabling Prospecting Drilling in the 21st Century?

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Abstract

Tier 1 mineral resource discoveries are critical to maintaining Australia’s, and indeed the world’s, mineral resource inventory without continuing decline in the grade of mined resources. Such discoveries are becoming less common because, increasingly, remaining prospective, underexplored areas are obscured by deep, barren cover. We argue that improving the rate of Tier 1 discoveries obscured by deep, barren cover requires a step change in mineral exploration techniques that may be provided by “prospecting drilling,” i.e., extensive drilling programs that map mineral systems beneath cover, enabling geophysical and geochemical vectoring toward deposits. The technological platform for prospecting drilling must include low-cost drilling due to the dense subsurface sampling required. Low-cost drilling may be provided by transferring coiled tubing drilling technology, with its continuous drill pipe on a reel, from the oil and gas sector. Key challenges to the deployment of coiled tubing drilling in mineral exploration, i.e., its rate of penetration in hard rocks, the durability of coiled tubing, and the recovery of cuttings, are being assessed and addressed by researchers of the Deep Exploration Technologies Cooperative Research Centre (DET CRC). The optimum technology platform for prospecting drilling would be coiled tubing drilling complemented by downhole and top-of-hole sensing, providing real-time petrophysics, structure/rock fabric, geochemistry, and mineralogy. The first manifestation of real-time, downhole sensing is our newly developed autonomous sonde that is deployed by the driller and logs natural gamma radiation as the drill rods are pulled. Our experimentation on real-time, top-of-hole sensing (on drill cuttings from diamond cored holes) has demonstrated cost-effective, rapid, repeatable, and accurate determination of geochemistry and mineralogy with the necessary depth fidelity. The rationale for prospecting drilling is provided by two examples: (1) a dataset of antimony from the Kalgoorlie district of Western Australia, which shows that subsampling at a 2-km spacing would map the mineral system and enable vectoring toward the contained deposits, and (2) analysis of hypogene alteration systems of iron oxide-copper-gold (IOCG) deposits in South Australia that presents the possibility of vectoring toward the deposits within such systems starting from >10 km distant. At the target cost of $50/m, coiled tubing drilling could cost effectively undertake prospecting drilling in large, covered provinces, such as the IOCG prospective Gawler craton of South Australia.

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