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Discrimination of Syenites Associated with Gold Deposits in the Abitibi Subprovince, Québec, Canada

M. Legault[1] and A.E. Lalonde[2]

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In greenstone belts of Archean cratons, an established spatial association exists between major faults, Timiskaming-type sediments, gold deposits, and felsic or syenitic intrusions. This association is interpreted either as a genetic link between gold and the intrusion, or as a structural link where the intrusion acts as a competent structural trap for late mineralization. For alkaline intrusions of the Abitibi Subprovince, many of the gold occurrences observed show indications that a genetic link exists between alkaline intrusions and gold mineralization. Three types of gold occurrences are spatially associated with alkaline intrusions in the Abitibi Subprovince: 1) gold-bearing disseminated sulphides, 2) Au-Cu-Mo disseminated sulphides, and 3) gold-bearing quartz veins. Although mineralization in this last type is clearly late relative to the alkaline intrusion, in the first two types it appears to be broadly coeval with the emplacement of intrusions. Even if this type of genetic link does exist between certain alkaline intrusions and gold mineralization, it does not necessarily mean that all alkaline intrusions are associated with gold occurrences. The ability to discriminate gold-bearing alkaline intrusions from seemingly barren intrusions could have important impacts on gold exploration and on the hypothetic genetic link between alkaline magmatism and gold. Geological setting, timing, and relationship with rocks of the Timiskaming Group, do not appear to have a major influence on the fertility of intrusions. However, the location of intrusions relative to major E-W faults seems to be very important. All of the alkaline intrusions that host a gold deposit are located less than 2 km from a major fault. "Fertile" and "barren" alkaline intrusions can generally be distinguished based on macroscopic, microscopic, and geochemical observations. Overall, "fertile" intrusions tend to form smaller (< 3 km^2) intrusions elongated along an E-W axis and spatially associated with major faults. They exhibit a porphyry texture, are locally brecciated, and are non magnetic. "Barren" intrusions on the other hand are mostly subcircular, equigranular and magnetic. They are also coarser-grained and trachytic textures are commonly observed. Geochemical discrimination is in the preliminary stages, but "fertile" intrusions tend to be more felsic than "barren" intrusions. Two preliminary discrimination diagrams are proposed. In cases where a genetic link appears to exist between an alkaline intrusion and gold mineralization, the latter would presumably be associated with metal-rich hydrothermal fluids, preferentially enriched in more felsic phases following magma fractionation. In cases where there is no genetic link between the alkaline intrusion and gold mineralization (gold-bearing quartz veins), more felsic intrusions would presumably offer a greater competency contrast with country rocks and would thus be more amenable to fracturing during subsequent deformation events. Although our work is preliminary, we are confident that this study will provide the mineral exploration industry with a quick and easy method to discriminate "fertile" intrusions from "barren" intrusions, thus allowing to focus gold exploration.

1 - Ministère des Ressources naturelles et de la Faune

2 - Department of Earth Sciences, University of Ottawa

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