Micro-analytical innovation for diamonds exploration and beyond

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Rio Tinto have developed an automated micro-analytical facility to provide high-volume, high-quality major and trace element mineral chemistry from kimberlitic indicator minerals an order of magnitude faster and less expensive than offered by current providers. The system has integrated a number of commercially available components. Grain recognition (as potentially mantle-derived) and major-element analyses are done using the Mineral Liberation Analyser (MLA). Trace-element analyses are done using an automated laser-ablation ICP-MS microprobe (LAM). The two systems are connected by proprietary software which allows automated LAM analysis of selected grains identified by the MLA as potentially kimberlitic. The EDS major element chemistry from the MLA has been verified with a range of tests against reputable external analytical facilities using conventional WDS microprobe. The facility has an annual capacity to analyse up to 1 million grains for major elements and up to 50,000 grains for trace elements, supporting Rio Tinto Exploration’s (RTX) diamonds exploration program globally. The availability of large volumes of high quality, low cost, major and trace element mineral chemistry combined with advanced multivariate statistical classification techniques has had a significant impact on the approach to diamond exploration by RTX.

Using the MLA to rapidly scan large numbers of grains to identify likely mantle-derived phases removes some of the reliance on manual picking to identify potential indicator minerals. Instead of detailed grain-by-grain selection and mounting, pickers can submit large populations of grains for probing (up to 2000 per single sample mounted on an epoxy block), reducing the risk of missing indicator minerals, particularly in environments with high chromite and/or garnet backgrounds. Low cost, high volume analytical capability has also enabled the collection of large reference data sets of garnet (n >150,000) and chromite (n > 25,000) mineral chemistry from global barren, fertile and background sources – essential to the in-house development of proprietary multivariate statistical classification systems used to assess the diamond potential of exploration targets. These classification systems offer a significant competitive advantage over conventional 2-dimensional kimberlitic indicator mineral chemistry plots which display a significant overlap with commonly encountered non-kimberlitic sources of chromite and eclogite garnet.

Utilising mineralogy and mineral chemistry for diamond exploration is a proven and highly successful exploration technique. In recent years RTX have utilised the innovative MLA-LAM micro-analytical configuration to develop new exploration techniques for copper, uranium, nickel and bauxite based on similar principles. Internal and external R&D is showing mineral chemistry has enormous potential to characterise ore systems as well as potentially vector towards them and assess fertility potential. In particular, the pioneering “Greenrocks” research undertaken by CODES which uses epidote and chlorite mineral chemistry to vector towards porphyry Cu systems and assess their fertility shows great promise. RTX is actively utilising the MLA-LAM analytical configuration to refine the “Greenrocks” methodology and apply it operationally in support of global copper exploration programs.