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Investigating pegmatite hosted gem quality garnet and tourmaline by selFrag liberation

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Pegmatite samples were collected from the Giyani Greenstone Belt in the Limpopo province of South Africa. The pegmatites contain possible gem quality garnet and tourmaline. A study was undertaken to describe the variability of the pegmatite veins and the tendency to mineralise with gem quality minerals. Hand- and core-specimens were prepared as thin sections for microscopy visual description and also analysed by X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF) and Electron MicroProbe (EMP).

Individual grains are usually liberated by crushing or acid digestion. The main drawback of these methods are that individual grains are damaged, broken into various pieces and softer included minerals are pulverised by the harder host minerals. The surface of the liberate grain is also not completely clean and may contain coatings or slithers of associated minerals. It was therefore opted to separate the grains with the use of a selFrag instrument.

The selFrag stands for Selective Fragmentation, an electric pulsed power process. High-voltage discharges are applied for the fragmentation, disintegration or disaggregation of solids. The mineral sample solids are submerged in a dielectric liquid such as water, oil or other organic liquids. In the course of a couple of micro seconds a HV discharge is deposited in the discharge plasma channel. High pressures and temperatures are generated in the process. As a result high pressure impulses propagate through the solids constituting the sample, causing it to break down due to induced mechanical stress. Reflections from acoustic non-homogeneities induce tensile stress in areas of grain boundaries, inclusions or interfaces of composites, causing the material to break predominantly at these non-homogeneities. Consequently composite materials are fragmented into their mineral grain components with a high degree of selectivity.

The coarse grained nature of the pegmatite made it ideal for testing the selFrag. The grains are more likely to be separated along the mineral grain boundaries, which can be visually inspected. Ideally the garnet and tourmaline should be liberated intact without damage to the garnet or tourmaline crystal and with clean surfaces. Mica should also liberated by the process in the original grain size and available for study, where it would normally be lost during conventional crushing.

The selFrag results of the pegmatite samples are used to establish a baseline for future use. It was noted that some samples were reduced to a powder, while other grains were not completely liberated along the grain boundaries during selFrag liberation. Microscopic visual inspection of the thin sections, related the grain boundaries and natural occurring fractures in the garnet and tourmaline to the size reduction during selFrag liberation at a specified selFrag setting. The size fraction of the liberated grains was also determined for each batch versus the average in situ size of the garnet, tourmaline and mica grains.

The selFrag instrument may potentially eliminated various common stumbling blocks in gemstone classifications such as repetitive mega-cryst mineral analyses and complications of single mineral grain analyses in matrix bound thin sections. Better individual classification is now possible by being able to set individual grains in mounds for further analyses by EMP. The possibility of future cost saving with the use of selFrag is also investigated with regards to thin-section production and microscopy hourly rates.