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Continuous measurement of Mg/Fe and Ca/Na ratios with scanning Laser Induced Breakdown Spectroscopy in 6 meter of drill core through Merensky Reef, Bushveld Complex, South Africa

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A 6-meter drill core from Merensky Reef, Bushveld Complex, South Africa, was scanned in detail with a drill core scanner based on Laser Induced Breakdown Spectroscopy (LIBS). The purpose of the investigation was to visualize variations in the chemical composition along the core, and following a mineral classification of the LIBS data, of variations in the mineral chemical composition, e.g. of Fe/Mg, Cr/Al, and Ca/Na ratios, as well.

The LIBS technology is based on atomic emission spectroscopy, in which the excitation of the atomic species occurs in-situ on the sample surface. The excitation source was a pulsed 50 mJ 1064 nm Nd:YAG laser, and the emitted light was collected with a high-resolution wide-range echelle spectrograph with CCD detector. This approach for measuring mineral chemical ratios such as Mg/Fe, Cr/Al, and Ca/Na, is based on the strength of LIBS in detecting chemical variations using intensity ratios within a single matrix, which in this application is one single particular type of mineral phase. For validation purposes, selected samples were analysed with bulk chemical analysis and electron probe microanalysis as well.

Distinct trends could indeed be extracted from the 6 m core section through the Merensky Reef. From a saw-cut core surface without further preparation, a continuous record could be extracted consisting of Mg/Fe of orthopyroxene, Ca/Na of plagioclase, bulk chemical patterns, modal composition, and direct neighbourhood. The data can be used to highlight the presence of unusual patterns and to relate them to Ni, Cu, PGE or other mineralization. When applied to different core sections, it may become an important tool for comparing lateral variability of diagnostic horizons in vertical sequences in layered intrusions such as Merensky Reef and UG-2.