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Synergy of Laser-Induced Breakdown Spectroscopy and micro-Computed Tomography for volume distribution of Pt in minerals

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The platinum group metals (PGMs) *i.e.* platinum, palladium, rhodium, iridium, osmium and ruthenium represent the key materials for automotive and their importance is steadily rising. Identification of selected metals in real time directly at the deposit sites is nowadays very complicated, especially at locations with extremely harsh climatic conditions and with no access to the local energy sources, such as Talnakh deposit, Siberia, Russia.

One of the most promising methods, which is a Laser-Induced Breakdown Spectroscopy (LIBS) technique [1]. LIBS is capable of real-time, non-destructive determination of the elemental composition of samples of any state of matter (solid, liquid, or gas) with a great potential for chemical mapping. Recently, LIBS potential has been well publicized when selected for Mars exploration. In order to obtain volume information about the samples, the micro-Computed Tomography (µCT) station has been employed. µCT in combination with LIBS is capable of the 3D spatial distribution and yields the amounts of selected metals in the sample volume. Both LIBS and µCT have already been developed as mobile devices demonstrating a great potential of these methods for *in situ* analysis.

The process of verification of LIBS and µCT as useful techniques for in situ mineral analysis and rare ores localization, respectively, was performed in following steps. It was found that the spatial distribution of each element from LIBS chemical map is in agreement with reference measurement obtained using the TESCAN Integrated Mineral Analyzer (TIMA). Then the tomograms were compared with LIBS chemical maps. The results from both LIBS and µCT were combined to prepare 3D chemical map of the sample. To prove the capability of LIBS to detect selected metals in minerals for larger distances (in our laboratory conditions the distance was limited to 6.2 m) a couple of measurements using so called stand-off LIBS were performed.

The final step of this analysis, principal component analysis was utilized to estimate the possibility of clustering of individual LIBS measurements and to classify individual measurements to corresponding matrices.

[1] Noll R. et al. (2012) Laser-Induced Breakdown Spectroscopy, Fundamentals and Applications. Springer. ISBN: 978-3-642-20667-2.

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