Preliminary srudy on analysis of minerals by laser-induced breakdown specroscopy(LIBS) for application to forensic geology

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Analysis of minerals by Laser-induced breakdown spectroscopy (LIBS) was preliminary examined for application to forensic investigation of sand grains.
Analysis was performed by LIBS J200 (Applied Spectra Inc.) equipped with CCD broadband detector and 266nm (25mJ) laser. Spot size of laser was 30 or 50 μm and range of analysis was from 190 to 690nm. Samples analyzed were quartz, feldspars, biotite, hornblende, augite, enstatite, olivine and muscovite as major rock-forming minerals, and magnetite, hematite, chromite, siderite, rhodonite, dolomite, and rutile as minerals rich in iron, magnesium, and some other elements. Examination on four iron and two aluminum standard alloys were also performed.
Experimental results showed obviously that number of peaks and their intensities varied widely depending on elements. For example, iron has hundreds of peaks in the range of detection with moderate intensities, but magnesium shows very strong peaks with relatively small number of peaks. This fact indicates that some of elements such as iron will hinder the search of other elements present in small amount, although magnesium as minor element can be detected if the coexisting elements have no overlapping peak.
Comparison of analytical results of major rock-forming minerals showed that peak patterns were different each other. The uniqueness of each result is attributed to elements with strong intensities rather than the type of mineral group. The results of feldspars indicate that it will be possible to estimate concentration of target elements in a previously identified mineral by microscopy or other methods, at least semi-quantitatively level.
Magnetite and hematite provided very similar results, and it was difficult to discriminate each other. Siderite is a mineral also contains a large amount of iron. But the sample used in this examination contained up to 10% of magnesium according to energy-dispersed x-ray analysis, and could be differentiated from magnetite and hematite. Rest of minerals showed different peak patterns from others. Identification of elements in iron-rich minerals required a hard task, and it is expected solving this issue will be an important issue for quantitative analysis.

Keywords: laser-induced breakdown specroscopy(LIBS), forensic geology

