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Nondestructive inspection for stone monuments using reflectance spectroscopy

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Stone is often used for materials of cultural heritages due to its engineering characteristics such as durability and hardness. Accurate and precise assessment of deterioration should be performed on the stone monument itself before practical conservation. Conventional assessments of rock deterioration used visual interpretation by geologists or chemical analysis of mineral composition using fallen rock pieces from stone monuments. These methods produced qualitative or indirect assessment results because the experiments were not performed on the stone monument, itself. Combinations of reflectance spectroscopy and various matching algorithms have been successfully used to classify geomaterials in field of remote sensing. This method can be applied to analysis of mineral composition and surface deterioration assessment for stone as a new nondestructive and direct inspection method. Most Korean stone monuments were made of granite, which is mainly composed of quartz, feldspar and mica. Different surface weathering grades among rock-forming minerals depend on their inherent hardness and durability. Hardness and durability against for weathering of quartz is greater than other granite forming minerals. Iron oxides and clay minerals are general weathering products of feldspar and mica. By using field spectrometer the spectral reflectances on the weathered granite specimens were measured and two diagnostic spectral absorption features of weathering products, iron oxides and clay minerals, were detected. The absorption feature of iron oxides was found in the vicinity of 0.95μm wavelength range and the absorption feature of clay minerals such as illite and kaolinite was found in the vicinity of 2.2μm wavelength range. Subtle offsets were found among maximum absorption peaks because of differences of mineral composition among measuring areas. To compare quantitative weathering degree, continuum removal process was conducted and absorption band depth was calculated numerically. A series of experiments using reflectance spectroscopy was applied to granite

blocks of Suwon fortress, Korea. On the granite block, surface conditions of invested points were converted to quantitative degree of weathering by combining band depths of two diagnostic absorption features. Finally, degradation map was produced by combining whole degrees of weathering of each inspected point and its spatial distribution.