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Portable Raman spectroscopy for the identification and characterization of limestones and dolomitic rocks

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The rapid in-situ characterization of limestones, dolomitic limestones and calcareous dolostones, might be crucial to speed up their recognition directly in the quarry. Therefore, the use of portable analytical techniques could be useful for this purpose. Among these, Raman spectroscopy is capable to identify and discriminate the presence of calcite and / or dolomite. The results obtained from the analyses carried out on carbonate rock samples show that Raman spectra obtained from a portable device lead to the identification of the main mineralogical components. Moreover, the intensity of the Raman signal appears to depend on the average size of the crystals constituting the carbonate rocks. In particular, it can be seen that the Raman spectra of rocks with an average crystal size of less than 50 μm show a worse signal/noise ratio.
The purpose of this research is to study the correlation between Raman signal efficiency and average crystal size. In this respect, the portable Raman spectroscopy could be considered as a valid technique to provide an instant estimation of the average crystal size. For this purpose, calcite crystals were grinded obtaining 12 different granulometric classes with a maximum diameter of 1 mm up to fine grains with a diameter equal or less than 4 μm. These samples were first analysed using standard petrographic techniques (polarized microscopy) on thin sections. Then rocks samples were analysed by means a portable Raman spectrometer using a laser excitation wavelength at 785 nm with a spectral resolution of 8 cm-1.
Results clearly show a decreasing of the signal efficiency reducing the particle size. Further aspect of the research will be focused on exploring the effect of the grains size on the Raman signal using different laser wavelengths (514 nm and 1064 nm). The micro approach will be also considered.
If the results were confirmed, this technique would allow to obtain double information, mineralogical and structural, and it would be very important during the extraction of the raw materials in order to understand deeply how the chemical and physical properties of the geomaterials may affect their transformation processes for the production of derived products.