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ENVIRONORAMAN: ENVIRONMENTAL APPLICATIONS OF NON-DESTRUCTIVE POLYVALENT MRM (MOBILE RAMAN MICROSCOPY)

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ENVIRONORAMAN has been defined (SMITH, 1999) as the study of bio- and geomaterials of relevance to environmental questions using the Raman spectrometric (RS) technique. As such it is one of a group of topics that compose the wider theme previously called GEORAMAN (SMITH, 1987): applications to geological science. Although biomaterials can also be analysed by RS, as it is one of the rare analytical techniques that can identify organic or inorganic solids, liquids or gases, we are mainly concerned here by geomaterials, especially crystals and their associations (e.g. rocks; deterioration products) in environmental mineralogy. RS has recently become transportable or portable, i.e. mobile, hence the symbol "MRM" which also emphasises the fact that one can observe a material under a microscope before choosing which micron-sized particle to analyse; there is no need to prepare a material or extract a sample in any way. Also, by employing optical fibres, one can analyse materials *in situ* far from the spectrometer by bringing an analytical apparatus to an object (on a ceiling or wall; inside a cave or drawer; under water) rather than taking a sample to a laboratory.

The technique is based on interatomic vibrations in crystals or molecules being excited by a laser and diffusing light with characteristic wavelength shifts. Transformed into a spectrum the result is a unique fingerprint which, through comparison with spectra of standards, identifies both the structure and chemistry of the material, and of each phase in the case of mixtures. MRM carries a unique range of advantages, and in certain circumstances provides the only possible way of acquiring identification data. Of course where materials are not precious, many alternative powerful physico-chemical, but destructive techniques may be convenient so that MRM would not be necessary.

It is difficult to conceive of a problem in environmental mineralogy where MRM cannot be of use as it is appropriate for identifying: dusts; particles suspended in liquid; components of soils or sediments; products of climatic, microbial or animal/vegetal degradation; corroded metals; minerals in domestic or industrial waste (and at the same time non-minerals if desired); as well as rocks. Concerning minerals in human health one can examine teeth, stones and implants (MEDICORAMAN). Concerning minerals within the cultural heritage (ARCHEORAMAN including art and architecture, as well as anthropology and ethnology) where most artefacts are indeed precious, the range of applications are enormous, e.g. rough, cut or mounted gems, and their inclusions and treatments; earthenware and other ceramics; stone axes or columns; corroded metal statues or weapons; and especially pigments on glass, wood, paper, pottery, plaster...

References

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