MS15 Crystallography in Earth and space

Chairs: Dr. Anna Pakhomova, Prof. JuanMa García-Ruiz

MS15-O1

Crystallography applied to the earth's lower mantle

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Crystal-chemistry studies have been essential in understanding the physical and chemical properties of minerals and their influence on the dynamic evolution of our planet. The use of diamond anvil cells coupled with X-ray sources has been an excellent tool to allows the structural characterization of new high-pressure phases and to help constraining the structural variations of these materials as a function of composition, pressure and temperature in order to shed light on the chemistry and structure of the deep Earth's. Silicate and oxide minerals, in particular, have been the focus of several studies in Geosciences, because of their abundance in the Earth's interior. Silicates transform with increasing pressure to denser phases having Si in 6-fold coordination and relatively simple structures (i.e. rutile-type, perovskite-type etc.), which have however significantly different properties depending on the extent of their cation substitution. The high-pressure high-temperature behavior of oxide minerals, on the contrary, appears very complex and it is characterized by a large and increasing number of new compounds. This variety of phases may contributes to the seismic observations so far obtained for the Earth's interior, therefore results on the structure-properties relationship of relevant minerals of the Earth's lower mantle will be discussed.

Keywords: high-pressure, Earth's mantle

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Mars mineralogy: The EXOMARS 2020 approach

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The Exomars program consists in two missions [1]. The first one, launched in 2016 is based on an orbiter carrying a Trace Gas Orbiter analyzer which is devoted to observe methane and other traces of gas present in the Martian atmosphere or emitted by the surface. The second, to be launched in 2020 consist in a rover carrying a drill capable to collect samples at the surface and below the surface down to 2 meters depth. The rover also contains at the interior an instrumental suite located inside the Analytical Laboratory Drawer (ALD) consisting in three instruments: 1- MicrOmega, an infrared spectrometer mainly devoted to the mineralogical analysis of the samples; 2- RLS, a Raman spectrometer also devoted to the mineralogical analysis and the organic detection on these samples and MOMA (Mars Organic Molecule Analyzer) devoted to identify organic molecules and potential biomarkers. These instruments will analyze the samples at the micro scale under the form of fine powder. Here interest is devoted on the Raman instrument and the role it will play inside the mission. The Raman effect is based on the inelastic light scattering process by the matter when illuminated by a laser. This extremely week effect contains information about the atomic and molecular vibrations of the illuminated material. Among the great advantages of the technique it is worth to mention the non destructive character of the analysis, not needs of physical contact and no sample preparation. In this work the technical development of the instrument to achieve a qualified flight-model will be described. Also, the mineralogical and astrobiological scientific objectives it will address in the framework of the mission objectives and the potential and capabilities it can offer during the operation along the mission on Mars. These capabilities will be illustrated on the basis of a wide experimental analysis at the laboratory and at the field, using in this last case potential terrestrial analogues to Mars.

References:

[1]- http://exploration.esa.int/mars/46048-programme-overview/
Keywords: Mars Mineralogy; Exomars Mission, Raman Spectroscopy

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