MINERALOGY OF NORTHWEST AFRICA 6963 DETERMINED BY RAMAN SPECTROSCOPY

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Introduction: Martian meteorites are important samples for understanding the present and past of Mars. They contain information about Martian geological evolution and physical and chemical characteristics [1]. The Martian meteorites are divided into three main groups: Shergottites, Nakhlites and Chassignites [2]. The shergottites are the most abundant among them and are also the most diverse of the Martian meteorite subgroups. They are divided into two types: basaltic and lherzolitic [3]. Northwest Africa (NWA) 6963 is a basaltic shergottite that was found in Morocco in 2011[4]. Previously studies show that NWA 6963 exhibits a range of textures with coarse mineralogy in a fine matrix [5]. Pyroxene, maskelynite are the dominant components in NWA 6963, ulvöspinel, merrillite, chlorapatite and pyrrhotite exist in minor amounts [6]. We are investigating NWA 6963 using multiple micro-spectroscopic techniques with the goal of revealing molecular composition of NWA 6963 in detail. These data will potentially allow us to understand processes that might be taking place on the surface of Mars.

Samples and Methods: We prepared a polished thin section from a thick slab of NWA 6963 at Istanbul Technical University, Department of Geological Engineering. Subsequently, micro-Raman imaging and spectral data on this sample was acquired at Canakkale Onsekiz Mart University, Science and Technology Application and Research Center. We used a WiTec alpha300 R (WiTec GmbH) confocal Raman imaging system equipped with a 532-nm Nd:YAG laser and a spectrometer with a CCD camera (cooled to -60 °C), and a 50X objective (NA = 0.8). Laser power was around 1- 3 mW. Integration time 0.2-0.5 s for two dimensional chemical distribution maps, and 1 second for individual spectra, for which 30-60 accumulations were collected. The collected data was analyzed using a commercial software package Project FOUR. First, cosmic ray lines were removed from the data and a background correction was applied. Second, various molecular phases were identified using their Raman band positions. These positions were then used to create two dimensional chemical distribution maps of respective phases.

Results: Raman spectra and chemical maps of NWA 6963 were collected from multiple locations on the surface of the sample. Collected data indicate that the studied sample is dominated by silicates and shock phases. Specifically, NWA 6963 contains abundance of pyroxene with multiple endmembers, evident from varying peak positions and spectral profiles. For instance, spectral profile of pyroxene bands between 280-428 cm^{-1} vary based on the chemical composition of the endmember. Additional Raman peaks for pyroxene appear at 667 and 1001 cm^{-1}. Maskelynite is also abundant in NWA 6963, it is evident from the broad Raman peak centered around 1065 cm^{-1}. Olivine presents a doublet near 840 cm^{-1}. Hematite presents multiple peaks, they appear at 224, 290, 404, 612, and 656 cm^{-1}. In addition to Raman, we have plans to collect infrared and electron microscope data on NWA 6963 to study its mineralogy and chemistry in detail.

References:

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