Spatial Distribution of Olivine in the Sinus Iridium Using M3 Data
Y. Z. Zhang1, C. Zhou2, S.B. Chen3, C. L. Li4, Z. J. Huang5, S. Huang6
1National Astronomical Observatories, Chinese Academy of Science, Beijing, China
2College of Geo-exploration Science and Technology, Jilin University, Changchun, China
3Institute of Space and Earth Information Science, The Chinese University of Hong Kong, Hong Kong

Introduction:
Olivine in particular is a useful mineral with which to evaluate the geologic evolution of igneous planetary bodies such as the Moon[1], as it is commonly the first mineral to crystallize from typical mafic magmas[2]. Recent results suggest that olivine is exposed largely in and around the rims of large lunar impact basins[3]. However, many of the detections are associated with exposures of plagioclase reported by Ohtake et al[4]. The distribution, composition and degree (high Mg# or low Mg#) of the olivine is an important indicative clue to the olivine’s source and history[1,5].

Here we present an olivine survey of the Sinus Iridium using M3 data. Based on the local geologic context, we found many exposures of olivine are located in the interior crater slopes and debris ejected from the impact-formed Iridium crater. Some of the olivine-rich sites are associated with plagioclase.

A. The Dataset
• Source: Moon Mineralogy Mapper (M3)
• Type: Global model Level-2 M3 reflectance data (540-2980nm)
• Spatial Resolution: 140m,
• Spectral Resolution: Varies between 20-40nm
• Preprocessing: Photometrically and thermally corrected
• Reflectance: collected one spectral reflectance curve at intervals of ten pixels in black box (Fig.1), and these areas are fresh craters and slopes where the effect of space weathering is minimal.

B. Spectral matching
To ameliorate the effect of the instrument distortions we fit the spectra using moving average method smoothing spline. Spectral Feature Fitting (SFF) is an absorption-feature-based methodology by least-squares technique, which for matching the unknown spectra to laboratory reflectance spectra using the depth and shape feature [6,7]. We have applied SFF to matching the spectra derived from the M3 data to the spectra of lunar samples measured in Earth-based laboratory (Fig.2), and the scale value is calculated for each reference spectrum. The points are selected as olivine-rich points, which obtained the highest scale value by comparing to the reference spectrums of the olivine.

C. The geological of each olivine-rich sites
In Fig.1 we plot 24 olivine-rich points on the mosaic image of Sinus Iridium. Most of these points are grouped into several sites. Therefore, we divided the 24 points to 5 sites (A,B,C,D and E sites in Fig.1). The representative spectra for the individual olivine-rich sites are shown in Fig.2. Most of the spectra in Fig.2 show clear olivine absorption bands within the wavelength range of λ=1050±50nm after removing a linear tangential continuum, on the other hand, the absorption valley position of spectra for adjacent to areas olivine exposures are tended to shift toward the right to longer wavelengths, which lead to unclear to allow correct interpretation of their mineral compositions. This may be due to the presence of minor amounts of plagioclase and plagioclase is difficult to detect in the near-infrared when mixed with absorbing mafic minerals like pyroxene and olivine.

Sites A, B and D are located on the slope material, which including relatively fresh rock fragments derived by slumping and spilling.
Site C is located on the debris ejected form the impact-formed Iridium crater, which is either roughly concentric or radial to crater.
Site E is located on the complex mixture of slumped Iridium ejecta.

D. Future Work
Concerning the olivine-rich material originate, the recent study propose two possible scenarios. The olivine exposures originated in the upper lunar mantle or originates form the mafic-rich lower crust [3], and some researchers identified in association with unusual exposures of olivine, orthopyroxene and spinel (OOS) [9,10], which supported for Mg-rich platon intruding into the lunar lower crust. Therefore, future work on this topic will make general predictions of olivine compositing (Mg/Fe content) with higher spatial resolution than the Global model of M3 image (140m).

References: