TERRESTRIAL NORITE-ANORTHOSITE SUITES AS ANALOGUES FOR MERCURY' SURFACE COMPOSITION. Cristian Carli[1], Maria Sgavetti[1], Loredana Pompilio[1] and Teresa Trua[1], [1]Department of Earth Sciences, University of Parma, via G.P. Usberti, 157, Parma, Italy. (cristian.carli@nemo.unipr.it).

Introduction: The Moon is generally considered an appropriate analogue of the surface composition of Mercury, based on the similarity between the spectrum of Mercury and the nearly featureless spectra of optically mature lunar pure anorthosite [1, 2, 3]. However, Hermean surface composition can be more complex, as indicated by VNIR and MIR data [4, 5, 6]. Besides the Earth, it is generally recognized that rocks have low probability of being exposed on terrestrial planets, due to the strong effect of space weathering. Consequently, planetary crust compositions are mostly estimated through the analysis of the regolith derived from the disintegration of exposed rocks [7, 8]. Space weathering is also responsible for different kinds of alteration, which modify and eventually mask the diagnostic spectral features of exposed materials [9, 10]. Therefore, a number of laboratory experiments are addressed to reproduce the weathering processes and determine the spectral characteristics of the alteration products of the upper crust of Mercury [11, 12, 13].

Here we propose the analysis of two genetic rock suites. The spectral characterization of these rocks can represent both the background for understanding the geologic significance of the regolith composition and the starting point for modeling surface alterations. These rocks include norites, gabbro-norites and anorthosites, and have significant analogies with lunar rock suites [14].

Background: The crusts of terrestrial planets and natural satellites largely consist of magmatic rocks, which are the natural products of magma-rock dynamic systems, controlled by T, P, oxygen fugacity and time. Individual rock-forming mineral assemblages represent well defined equilibrium points in the system evolution. Although initial magma composition and physical constraints could have been different, planets share common origin and genetic processes, whose evolution can be traced starting from rock compositions.

The surface of Mercury appears to be highly depleted of both dark opaque phases (such as ilmenite and rutile Ti-oxides) and Fe^{2+} in mafic minerals [1, 15]. Mariner 10 data gave evidence of diversity in surface composition between adjacent areas of Mercury [4, 5, 16], and some color units are consistent with basalt or gabbro compositions [6]. Similarly, spectral data in the MIR indicate a spatially heterogeneous surface composition [15, 17, 18], with strong evidence of both Fe-poor pyroxenes and intermediate feldspars. The wavelength of the Christiansen feature near 8 µm indicates surface rocks of basic or intermediate composition [15, 17]. Intermediate to ultrabasic soils were also inferred [18]. A number of highly different petrologic systems characterize the Earth. Some systems comprise rock suites with systematically varying compositions and can encompass the range of composition of rocks expected on other terrestrial planets. Well known absorption bands characterize most rock-bearing minerals. The wavelength variation of the most diagnostic bands is related to the mineral chemistry variation [19, 20] and, for a given geologic system, is also correlated with the rock composition variability [21].

The terrestrial rock suites: The Bjerkreim-Sokndal (BKSK) and Stillwater Complex (SWC) cumulitic layered intrusions were emplaced about 931Ma and 2.7Ga, respectively [22, 23]. BKSK Layered Series crystallized in a continuously fractionating, periodically replenished magma chamber. Six replenishment events have been accounted and jotunite has been estimated as the parent magma [22]. SWC was built up by two compositionally different magmas: a MgO and SiO_2 rich magma (olivine-saturated) which formed the Ultramafic Series, and a tholeitic magma from which the Banded Series originated. Cumulitic plagioclase occur within the whole series of both BKSK and SWC-Banded Series. Additional main rock-forming minerals are well ordered orthopyroxene and opaques, and clinopyroxene (Cpx) and orthopyroxene (Opx), within BKSK and SWC rocks, respectively.

Methods: Reflectance spectra were measured on mineral mixtures (125-250 µm average grain size), representative of the two suites. Rock samples of SWC were ground and dry sieved. Separates of few BKSK rock-bearing minerals were used both for spectral measurements of individual phases and to form synthetic mixtures with several relative abundances. BKSK samples represent a reference for the "natural" sample set of SWC. Total reflectance spectra were measured using a double-beam, double monochromator spectrophotometer (Perkin-Elmer, Lambda19), with 0.35 – 2.5 µm spectral range and 1 nm spectral resolution. Modified Gaussian Model [24] was used to separate the contribution of Opx and Cpx and to determine the position of band I center (near 0.9 and 1.0 µm, respectively).

Results: *Band minima vs mineral chemistry*. As expected, fitting parameter results for SWC spectra split into two groups, which plot within the high Ca and low Ca pyroxene fields of figure 4 in [19]. BKSK data plot within the Opx field (Fig. 1). As regard Opx, the systematic variation of band minima with Fe^{2+}/M2 sites content is shown by the high correlation value of the regression line in figure 2.

Band depth vs modal composition of rocks. A good linear relationship exists between pyroxene band I intensity and the pyroxene modal abundance within powdered samples belonging to the SWC and the synthetic pyroxene/plagioclase mixtures obtained from BKSK separates (Fig.3).

Comparison with lunar samples. We used spectra of 2 lunar rock samples (78235,34/LS-CMP-012 and 60019,215-G3/LS-CMP-015-G3 from NASA's RELAB facility at Brown University) for comparison with terrestrial rocks. The former is a pyroxene separate from lunar norite and the available chemistry allowed the corresponding data point to be plotted in figures 1 and 2. According to band parameters, it behaves as terrestrial orthopyroxenes although a slight deviation from regression line, probably due to the higher Ca content in the lunar pyroxene . Modal composition available for lunar clast 60019,215-G3/LS-CMP-015-G3 allowed it to be compared with powdered samples and mixtures from terrestrial rock suites (fig. 3). r slightly decreases when the lunar sample is included in the regression but the correlation still occurs with high confidence level.

Conclusions and future work: 1) Using a band fitting technique, both mineral chemistry and modal abundance can be estimated with fairly good accuracy for complex mixtures like powdered rocks. 2) The very preliminary results of comparison between lunar rocks and both the cumulitic layered series encourage ourselves to carry on spectral analyses of these genetically-related rocks with the aim to build calibration curves and reference libraries to be used for mapping Mercury' surface. 3) Further work is still required in order to simulate the weathering effects on these rocks and thus allow comparison with Hermean soils.

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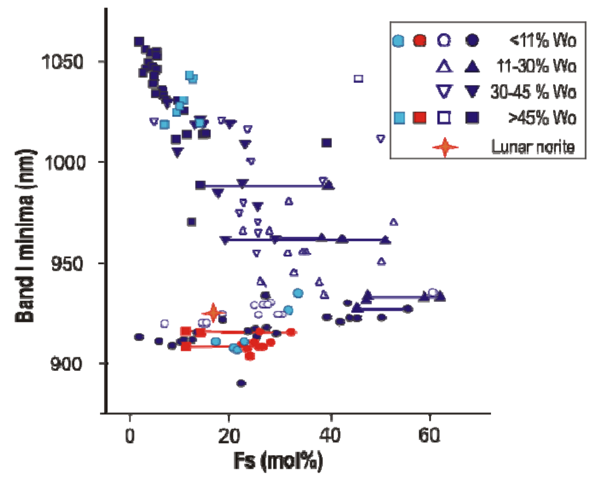

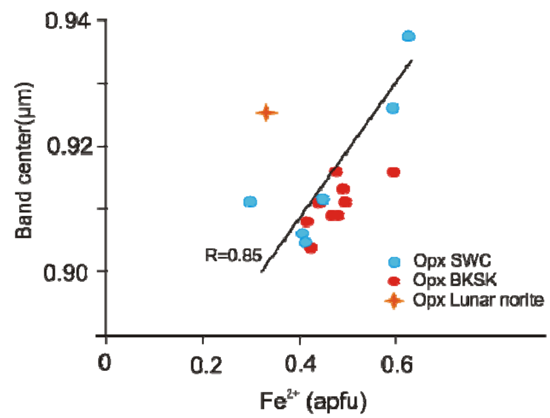

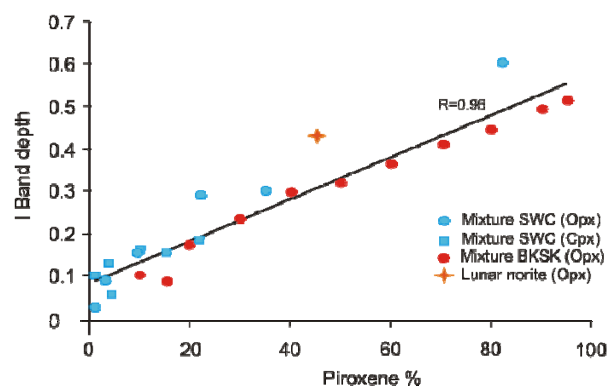

Fig. 1: Pyroxene band I position vs molar Ferrosilite in pyroxenes. Modified after [19, 21]. Red and Cyan symbols: BKSK and SWC. Lunar sample: 78235,34/LS-CMP-012. **Fig. 2:** Pyroxene band I position vs Fe^{2+} abundance. Lunar sample: 78235,34/LS-CMP-012. **Fig. 3:** Pyroxene band I depth vs modal pyroxenes. Lunar sample: 60019,215-G3/LS-CMP-015-G3. Modified after [21].

Acnowledgements: This research utilizes spectra acquired by C. M. Pieters with the NASA RELAB facility at Brown University. We grateful recognize financial support from ASI.