INTRODUCTION

ESA/Roscosmos ExoMars mission will soon deliver a surface platform and a rover to the Martian surface, at Osia Planum [1]. Crustal magnetic field information is crucial to understand the surface and subsurface properties and geological history. Measuring the magnetic field signals is one of the objectives of the AMR (Anisotropic Magnetic Resistance) sensor [2] part of the Meteorological package within Kazachok surface platform. The magnetic field signature of different terrestrial analogues will help to understand the future acquired magnetic field measurements on Mars and allow a better characterization of the local geology. Here we focus on Cerro Gordo (CG) volcano, proposed to be an analogue for some Martian volcanos, and the mixed volcanic structure magnetic signals. Figure 1 shows XRD targeted terrestrial analog. Cerro Gordo volcano, to the Ulysses Colles, Tharsis Mars. It has to be remarked that in comparison, Martian strombolian volcanos are expected to be larger in size than their terrestrial counterparts given the different gravity and atmospheric conditions of both planets [3]. It is very likely that the Martian volcanos area is magnetized, given the available information from spacecraft magnetic data that shows a saturation of spherical samples pose large-scale signatures with limited spatial resolution in contrast to the upcoming near-ground and on-ground measurements.

GEOLOGICAL DESCRIPTION

CG volcano, from the Campos de Calatrava volcanic province, is located close to Ciudad Real, Spain (38.833073°N 3.743197°W). It is a volcano formed between 4.7 and 1.75 million years ago, related to an intraplate volcanism formed in a lacustrine area with different types of eruptions. The volcanic building is found to be hosted on an Armancan quartzite basement, composed of four main phases [5]: two phreatomagmatic and two strombolian phases, in the formation of some spatter lava flows on the southeastern slope of the volcano. The principal geological structures such as lava flows, spatter flows, and the volcanic bodies, are highlighted in Figure 3. Two phases of the CG volcano can be expected on Mars, and the preparatory campaigns for the characterization of Martian volcanos need to consider only monogenetic volcanos but also mixed basaltic [6][7]. Past studies [8] described the mineralogy of the volcano as olivine nephelinites, with high contents of mafic minerals, highly magnetized in both the northern lava and the spatter flows. We have collected 16 samples in total: 10 lava-spatter and 6 scoriae, the most representative of each deposit. We show in the following laboratory analysis of a spatter sample.

MAGNETIC CHARACTERIZATION OF CERRO GORDO ROCKS

We have measured the magnetic properties of a spatter sample from Cerro Gordo by means of a VSM (Vibrating Sample Magnetometer). The hysteresis loop (Figure 4 left) presents a wash-waist shape, which suggests the presence of two mineral phases in the sample: a ferromagnetic phase and a paramagnetic or superparamagnetic (SP) phase that produces the narrowing in the central zone. The position of the sample on the Day plot [9] in figure 4 (right), together with the geochronomagnetic characterization results, confirm those phases. From the diagrams and the chemical data, it can be inferred that the ferromagnetic phase could be magnetite or pyrrhotite as the most common magnetic phases. Furthermore, the paramagnetic phase could be a titanium-rich phase (titano-magnetite).

MAGNETIC FIELD SIGNATURES OF CERRO GORDO VOLCANO

A previous magnetic survey at 5 m constant altitude has been performed over two of the volcanic structures: the northern lava flow and the northern spatter deposit [10]. The respective measured magnetic anomalies along the various flight tracks is shown in Figure 6. Over the northern lava flow region, the obtained magnetic anomaly reaches intensity values of up to 1500 nT. High spatial frequency signal is observed and can be the result of a worked agricultural land, where the rocks magnetic orientation does not remain original. Over the northern spatter deposit, the magnetic anomaly reaches intensity values around 3500 nT, showing a pattern with the hypothesis of the spatter being formed, and consequently magnetized when the global magnetic field was in the opposite direction of today’s main field.

Further magnetic surveys at 10 and 20 m altitudes will be performed along a horizontal line, crossing all the main building structure of the volcano. This future survey will allow a complete characterization of the magnetic signature of this analog.

REFERENCES


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