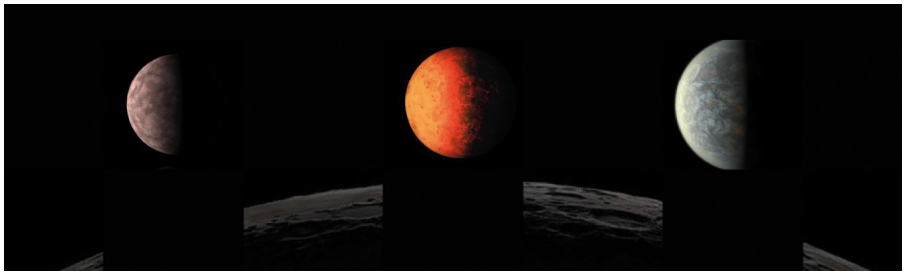

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Evaluating the origin of Mars crustal magnetisation through a statistical analysis of the crustal magnetic anomalies orientations

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The Martian crust shows a magnetic contrast between the northern and southern hemispheres. Data from MGS and MAVEN reveal strong magnetization and E-W anomalies in the southern one whereas weak in both the northern one and within major impact basins. The origin of this magnetization remains uncertain. Exogenic (impacts) or endogenic (degree-1 convection or mantle plume) process could be the possible cause. This study analyses anomalies at the planetary scale to test the hypothesis of a global event. Intensity of anomalies was derived from the radial magnetic field on a 3393.3 km sphere. Thresholds of ≥200 nT and ≥500 nT were used to enhance the patterns. Mapping was performed using grid-based skeletonization. We classified the anomalies as radial or circumferential in relation to fictitious centres every 5° in latitude and longitude. We produced density maps and a geometrical best-fit analysis of the distribution of circumferential anomalies. We also conducted a tectonic structure orientation analysis in some areas around the fitted ellipse. The radial magnetic field highlights the main anomaly patterns. Results indicate that 50% of the anomalies likely stem from a single event, displaying global antipodality and forming an elliptical coherent system. The evidence is consistent with crustal magnetization as an outcome of a large impact, most likely the formation of the pre-Noachian Borealis basin (~4.5 Ga). This event may have generated the anomaly system, producing post-impact hydrothermal or igneous fluids circulating through fractures. Preliminary geological investigations support this interpretation, with tectonic structures aligned to the fitted ellipse and the dichotomy boundary. The remaining anomalies would originate from later processes.

Primary author: ORLANDUCCI, Claudio (Centrum Badań Kosmicznych Polskiej Akademii Nauk, Warszawa, Poland)

Co-authors: MÈGE, Daniel (Centrum Badań Kosmicznych Polskiej Akademii Nauk, Warszawa, Poland); LANGLAIS, Benoit (Laboratoire de Planétologie et Géosciences, Université de Nantes, Université d'Angers, CNRS, UMR 6112, Nantes, France); MITTELHOLZ, Anna (Department of Earth and Planetary Sciences, ETH Zurich, Zurich, Switzerland); DYMENT, Jérôme (Institut de Physique du Globe de Paris, Sorbonne Paris Cité, Université Paris Diderot, UMR CNRS 7154, 1 rue Jussieu, 75238 Paris 05, France); GURGUREWICZ, Joanna (Centrum Badań Kosmicznych Polskiej Akademii Nauk, Warszawa, Poland); POPPE, Sam (Centrum Badań Kosmicznych Polskiej Akademii Nauk, Warszawa, Poland); QUESNEL, Yoann (Aix-Marseille Université, CNRS, IRD, INRAE, CEREGE, Aix-en-Provence, France); TESSON, Pierre-Antoine (Centrum Badań Kosmicznych Polskiej Akademii Nauk, Warszawa, Poland)

Presenter: ORLANDUCCI, Claudio (Centrum Badań Kosmicznych Polskiej Akademii Nauk, Warszawa, Poland)

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