Brachinites VNIR reflectance, same achondrite group connecting S-type and A-Type asteroids.

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Introduction: Brachinites are an olivine-rich meteorites group displaying equilibrated textures and homogenous mineral phase compositions. Recently, the connection of ungrouped achondrites with brachinites affinity to brachinites has been strengthened [1,2]. The authors investigated 15 samples and compared the results with literature, suggesting that those meteorites should be considered as part of the same group, and derived from the same source, e.g., same parental body, or at least the same reservoir. The main variation within the group could be explained in terms of different initial oxygen fugacities within the region where the parental body accreted [1]. Reflectance properties of few brachinites were measured, but no systematic work has been done on those meteorites yet. Here, we investigate the reflectance properties of 12 brachinites studied in [1] and compared them with laboratory data of other brachinites present in the literature.

Methods: Meteorite spectra were measured using the Fieldspec Pro spectrophotometer mounted on the goniometer present at the S.LAB. laboratory at IAPS-INAF, Rome. The data cover the spectral range of 0.35–2.50 μm with a spectral resolution from 3 nm in the VIS and 10 nm in the NIR, at fixed illumination and viewing angles of 30° and 0°, respectively. The source was a QTH lamp and the spot illuminated had a diameter of about 6 mm. The standard reference calibration was performed with a Spectralon optical standard 99%. Spectra are an average of 100 acquisitions. The meteorites have been characterized from a mineralogical, geochemical and petrographical point of view at MEMA – Department of Earth Sciences of Florence [1,2].

Results: Reflectance spectra show systematic variation between pyroxene-dominated and olivine-dominated assemblages. Brachinites with a more reduced mineralogy show mainly olivine-dominated spectra. However, among the brachinites with more oxidized mineralogy, about 40% of investigated samples show spectra not dominated by olivine, even if the olivine abundance is always higher than 63 vol. % [1]. Comparing band center around 1 μm with the band area ratio, the brachinites cluster defines a relatively large field. They partially overlap with the spectral range in which some of the ordinary chondrites fall (in particular LL) and where plot some of the measurements of the Dydimos-Dymoerphous binary system [3], which was recently investigated by DART and Hera mission and which composition is still debated. Moreover, these results compared with [4] clearly evidence a variation from SIII up to olivine-roch asteroids, including S-subtypesor A-type .

Discussion: The spectral properties in the VNIR highlight that brachinites are distinct from other groups of achondrites, e.g., acapulcoites-lodranites, ureilites (see also [5] and references therein), and obviously HED. This indicates that some of brachinites are the only one showing a strong affinity with olivine spectral properties, so far. Considering that brachinites can be attributed to one parental body [1,2], the variation of VNIR spectra among the group indicates that spectral properties of the parental body could vary between two different asteroid types from pyroxene dominated up to olivine dominated.

Implications: In general, achondrites (excluding martian and lunar) show a cluster of spectral properties indicating pyroxene affinities. So far, only a few diogenites showed spectra dominated by olivine (see [6]). Remarkably, brachinites clearly show the presence of olivine and a spectral variability indicating that objects from the same parental body can span from different type of asteroids following the taxonomic classification, in this case from S-Type up to A-Type. This indicates that we should expect objects from the same asteroid family to span between different asteroid types. This is in agreement with the recent work on the 1999 XT17 asteroid family, which matches both A-Type and complex S-Type asteroids [7].

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