Development of inflated lava tubes in analogous planetary environments: the case of La Corona system (Lanzarote, Canary Islands)

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Multidisciplinary efforts are currently boosted by an urgent need to improve our understanding of Earth's lava systems in sight of their future exploration on other rocky bodies of the Solar System.

Among the many structures documented in lava fields, lava tubes are one of the most enigmatic. They constitute a peculiar type of caves dug by molten lava flows. These roofed conducts are very efficient thermal structures enabling channelizing lava transport over long distances. The longest lava tubes are found on volcanic plateau characterised by a gentle slope (<2°) or on volcanic islands (e.g. Hawai'i, Canaries, Iceland, etc.). These structures are easily recognizable from the surface by skylights and collapses on the roof forming pits chains, which allow the reconstruction of the tube path. Due to the similar characteristics of basaltic volcanism on other rocky bodies (e.g. Mars and the Moon), it is expected that lava tubes have similar origins and morphologies to those on Earth. Indeed, analogous conformations of aligned collapses have been seen on the surfaces of Mars and the Moon (Haruyama et al., 2012). This discovery has led to a growing interest as these structures could be suitable sites for future exploration and/or permanent human settlement.

Located in the north-eastern part of the island of Lanzarote (Canary Islands), the La Corona lava tube system with its 7.6 km of total length (~8.9 km of cave development) and 10-20 m diameter is one of the terrestrial largest volcanic cave complexes. Accordingly, to the particular geological context in which it arose, La Corona system is one of the most studied. Indeed, the Canarian archipelago represents both long-term and spatially focused volcanic activity over a poorly mobile tectonic plate [less than ~2 cm/yr, during the last 30 Ma (Gaina et al., 2013)]. This environment identifies the Canaries as one of the best analogues of the Martian one-shell plate volcanism on Earth (Meyzen et al., 2015). What makes this inflated lava tube so interesting is a pyroclastic layer, derived by the initial Strombolian activity of La Corona vent (Carracedo et al., 2013) and interleaved within the lava flows crossed by the tube. The layer follows the tube for at least one-third of its extent and we speculate that it could have been pivotal for the inception of the inflation process. By analogy, similar geological settings could be favourable for the formation of lava tubes on rocky bodies like Mars and the Moon, where weak layers of pyroclastic deposits or fine regolith are thought to be common.

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