NATURAL SHELTER ON OTHER WORLDS; Bryce Walden, Oregon L-5 Society, Inc., P.O. Box 86, Oregon City, OR 97045-0007.

Gigantic lavatube caverns can provide safe and comfortable shelter on other worlds. Basaltic lavas generally follow the same rules on the Moon, Mars, Venus, and Mercury as on Earth. Under certain conditions of high-temperature, highly-fluid flow it is almost inevitable that lavatubes will form, and where such conditions are right lavatubes are numerous features in the landscape. Although lavatubes have never been probed or explored on other worlds, evidence in the slopes of giant Martian shield volcanos and on the margins of the lunar maria strongly implies their presence.(1) A very reliable indicator is the collapse trench, a sinuous rille created in the period immediately following withdrawal of lavas when sections of a drained lavatube collapse. Lavatube segments that survive lava withdrawal are strong and stable.(2) It appears certain that in any area of sinuous rilles, discontinuous segments indicate lavatube caverns. Another sign of lavatube caverns, and this seen frequently with the discontinuous rille, is a linear series of "dimple craters" without rims, caused by spot-collapses in the lavatube roof allowing regolith to "drain" into the cavern.

Comparison of sinuous rilles on other worlds to collapsed lavatube trenches on Earth leads to several conclusions. On Earth, widths of hidden lavatubes are indicated by widths of associated collapse trenches. Lighter gravity on other worlds permits wider lavatube spans, over 300m on the Moon.(3) Based on rille depth, height of the lavatube cavern can be over 200m. Lunar lavatubes may be kilometers long. Lavatube roofs on the Moon are over 40m thick and can sustain moderate meteor impacts (20m dia. craters). Therefore, lunar and martian lavatubes could house large bases. 40m of basalt and regolith will protect both construction and operations. Constant temperature $\approx$ -20°C reduces thermal stress on structures and machines.(4) Lavatubes may be the only lunar or martian locations relatively free of troublesome dust.

Lavatubes have certain features which can be put to beneficial use. The roof typically is arched and may anchor hanging fixtures, platforms, transportation systems, and habitats, whose weights will be reduced in accordance to their locations on Mars or the Moon. The roof may be pierced to shorten power, communications, and transport connections to the surface. Walls are commonly parallel and may be used as braces for base elements. Parallel bench formations provide natural support for elevated base elements with room in the lower passage for utilities, transportation, etc. Although much floor area is expected to be covered with large blocks, there may be many areas of relatively level and even smooth floors left by cooling lava ponds within the lavatube. Beside their convenience for foundations, such exposures of solid bedrock are also useful for anchoring heavy machinery and manufacturing facilities.(5) Some floors will have channels in them, which may be large enough for utility services or even sub-habitats, roofed-over and pressurized. (Large volume of lavatubes and presence of contraction cracks through the basalt flow make sealing whole lavatubes impractical at present.) Construction can begin with operational modules themselves, and base operations can commence faster than with equivalent surface facilities requiring additional shielding.

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