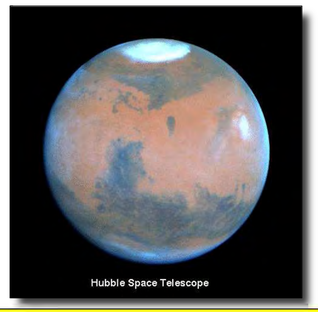
1613 OCCURRENCE AND ABSENCE OF LAVA TUBE CAVES WITH SOME OTHER VOLCANIC CAVITIES;

A CONSIDERATION OF HUMAN HABITATION SITES ON MARS

W. Halliday (1,2), G. Favre (1,3), A. Stefansson (4), P. Whitfield (5) and N. Banks (6)

1) Commission on Volcanic Caves of the International Union of Speleology
2) Hawaii Speleological Survey of the National Speleological Society
3) Swiss Speleological Society
4) Thrihnukar e.h.f., Reykjavik
5) British Columbia Speleological Federation
6) US Geological Survey (retired)


Hubble Space Telescope

HAWAII'S KAU DESERT PIT CRATERS

AT THE 2011 FIRST INTERNATIONAL PLANETARY CAVES WORKSHOP, SEVERAL PAPERS DESCRIBED ARCHITECTURAL AND/OR ENGINEERING PROJECTS INTENDED FOR LAVA TUBE CAVES AT THE BOTTOM OF PIT CRATERS.

EXAMPLES OF MISSTATEMENTS ABOUT KAU DESERT PIT CRATERS

IN 1839, JAMES DANA RECOGNIZED PIT CRATERS AS REMNANTS OF SINGLE POOLS OF MOLTEN LAVA WITH WITHDRAWAL OF THEIR LAVA COLUMN. YET NUMEROUS PUBLICATIONS SUBSEQENTLY HAVE STATED THAT HAWAII'S KAU DESERT PIT CRATERS ARE CONNECTED TO LAVA TUBE CAVES AND/OR TO EACH OTHER. SUCH COMBINATIONS OF PIT CRATERS AND LAVA TUBE CAVES ARE WIDELY CONSIDERED TO BE ANALOGUES OF "BLACK HOLES" OBSERVED ON MARS AND THE MOON.

BUT DIRECT FIELD OBSERVATION HAS SHOWN THAT NO SUCH CONNECTIONS HAVE BEEN DEMONSTRATED ON EARTH.

"SOME SIMILAR HOLES... IN THE KAU DESERT ARE BUT BREAKDOWNS IN THE ROOFS OF (RIFT) TUBES" (VOLCANO LETTER #82, 1926)

"THE PITS ARE ... CONNECTED BELOW BY A LARGE LAVA TUBE" (NASA CR-152416 & TMX 62362,1974)

"AT KILAUEA THERE ARE PIT CRATERS THAT HAVE EXTENSIVE SYSTEMS OF UNDERGROUND CAVERNS AND LAVA-TUBE CAVES" (VOLCANO WATCH 11-18-10)

NO TERRESTRIAL PIT CRATER HAS BEEN FOUND TO BE A SKYLIGHT OF A LAVA TUBE CAVE, AND IN OUR OPINION, THERE IS LITTLE CHANCE OF SUCH A FEATURE ON MARS OR THE MOON.

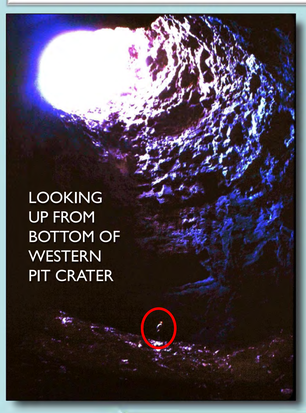

KAU DESERT PIT CRATERS AS SEEN FROM CONE CRATER

WESTERN PIT CRATER

"BATHTUB RINGS" DEPOSITED BY SUBSIDING LAVA LAKE LEVELS.

LOOKING ACROSS INITIAL SLOPE OF WEST WALL OF WESTERN PIT CRATER TO EASTERN PIT CRATER (UPPER RIGHT) AND CONE CRATER (UPPER LEFT). SIMILAR-LOOKING SLOPES HAVE BEEN OBSERVED IN SEVERAL MARTIAN PIT CRATERS. LATERAL SPILL OF LAVA INTO PIT IS RECENT.

THE FIRST KNOWN INVESTIGATION OF THIS PIT CRATER WAS IN 1979. NO LAVA TUBE CAVE WAS FOUND. FINDINGS WERE PRESENTED AT THE 1982 3RD INTERNATIONAL SYMPOSIUM ON VULCANOSPELEOLOGY

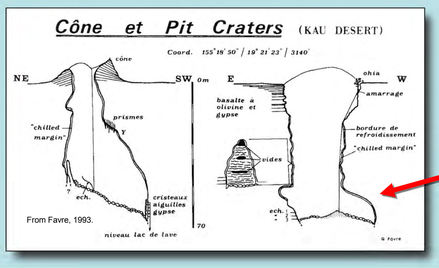

LOOKING UP FROM BOTTOM OF WESTERN PIT CRATER


BOTTOM OF WESTERN PIT CRATER

EASTERN PIT CRATER

LOOKING DOWN EASTERN PIT CRATER FROM RIM.

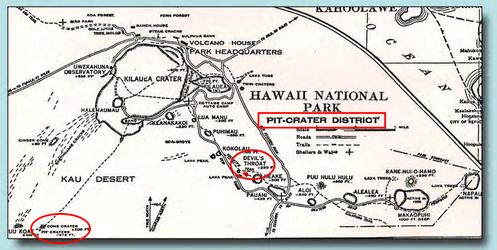
THE FIRST KNOWN INVESTIGATION OF THIS PIT CRATER WAS IN 1981. NO LAVA TUBE CAVE WAS FOUND. FINDINGS WERE PRESENTED AT THE 1982 3RD INTERNATIONAL SYMPOSIUM ON VULCANOSPELEOLOGY AND IN ITS PROCEDINGS VOLUME.



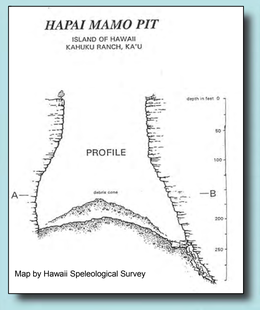
THIS ALCOVE HAS BEEN MISINTERPRETED AS THE ORIFICE OF A LARGE LAVA TUBE CAVE

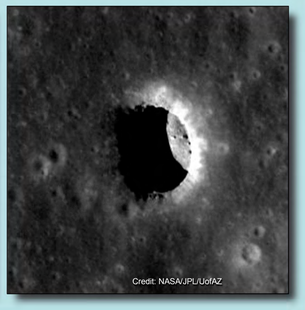
WHAT PIT CRATERS ARE AND ARE NOT

THIS NATIONAL PARK SERVICE ca. 1923 MAP OF "THE PIT-CRATER DISTRICT" SHOWS THE TYPE LOCALITY OF THREE TYPES OF TERRESTRIAL PIT CRATERS.



TWO EXAMPLES OF THE CYLINDRICAL TYPE ARE SHOWN IN THE KAU DESERT, AND ABOUT A DOZEN LARGE CUP-OR BOWL-SHAPED EXAMPLES. DEVIL'S THROAT WAS A GOBLET- OR BOTTLE-SHAPED TYPE WITH OVERHANGING WALLS, THEN IN THE PROCESS OF COLLAPSE.

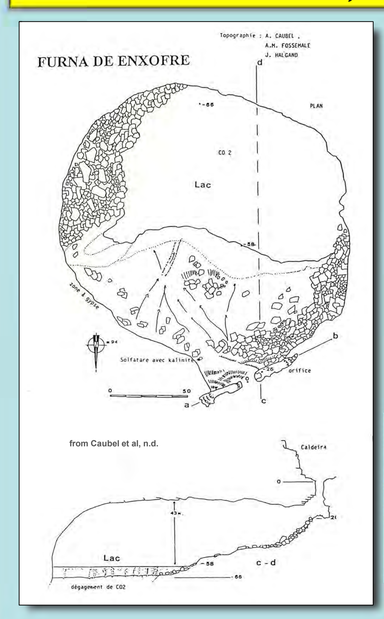



Credit: NASA/JPL/UofAZ

A SMALL PIT CRATER NEAR THE GREAT CRACK SHOWS RESIDUALS OF ITS LAVA LAKE

BOTTLE-SHAPED PIT CRATERS OF EARTH AND MARS

FURNA DO ENXOFRE, AN INCIPIENT PIT CRATER

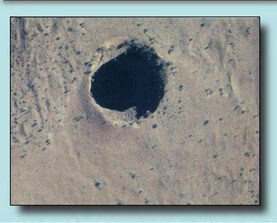


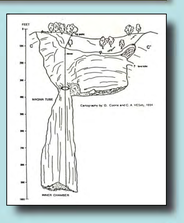

PHOTOS BY GREGORY MIDDLETON

THE MASONRY TOWER HOUSES AN ACCESS STAIRWAY ABOUT 25 METERS HIGH

FORMED WITHIN A CALDERA ON GRACIOSA ISLAND (AZORES), FURNA DO ENXOFRE IS A UNIQUE INCIPIENT PIT CRATER. THE ONCE-THIN LID OF ITS LAVA LAKE EVIDENTLY WAS OVERRUN BY INTRA-CALDERA FLOWS BEFORE ITS COLUMN OF MOLTEN LAVA WITHDREW. THE RESULTING CAVITY IS MANY TIMES WIDER THAN ANY TERRESTRIAL LAVA TUBE CHAMBER OR PASSAGE.

NA ONE PIT, HUALALAI VOLCANO, HAWAII

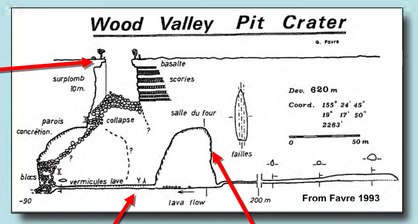


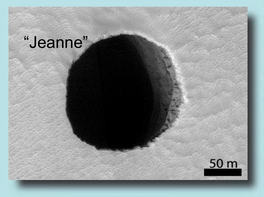


NA ONE IS THE ONLY PIT CRATER ON RECORD WITH AN OPEN CONNECTION OF MORE THAN TRIVIAL SIZE TO A DIFFERENT TYPE OF VOLCANIC CAVITY: AN OPEN VERTICAL VOLCANIC CONDUIT 173 METERS DEEP. TOTAL DEPTH IS 295.3 METERS. DESPITE PUBLISHED STATEMENTS TO THE CONTRARY, NO TERRESTRIAL PIT CRATER ON RECORD HAS A CONNECTION TO A LAVA TUBE CAVE.

OTHER TYPES OF POTENTIAL HABITAT CAVES

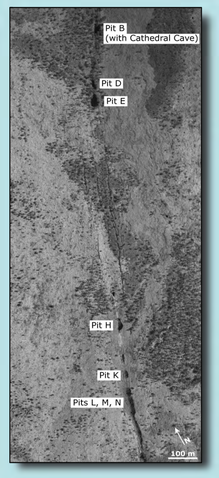
HAWAII'S MIS-NAMED "WOOD VALLEY PIT CRATER" IS THE SOLE DOCUMENTED TERRESTRIAL DILATIONAL FAULT CAVE WITH A COLLAPSE ENTRANCE LARGE ENOUGH TO BE MISTAKEN FOR A PIT CRATER. LIKE "JEANNE" ON ARSIA MONS, A PLANAR WALL REVEALS ITS ORIGIN. ENTRY IS THROUGH SHARP-EDGED BREAKDOWN UNFRIENDLY TO SPACE SUITS.



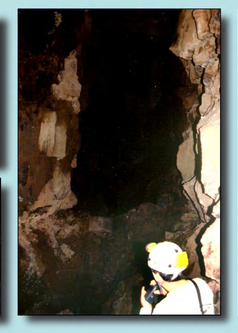


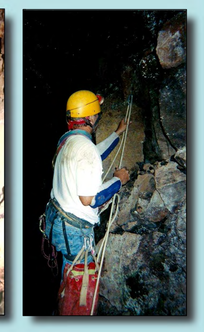
THEMIS VISUAL IMAGE, CUSHING et al. (2007), GRL L17201

ERUPTIVE FISSURE CAVES



SINKHOLE ENTRANCES TO CREVICE CAVES ALONG THE PIT H SECTION OF HAWAII'S GREAT CRACK HAVE BEEN MISIDENTIFIED AS PIT CRATERS. SUCH ERUPTIVE FISSURES ARE EVEN MORE UNFRIENDLY TO SPACE SUITS.



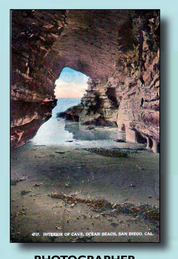


OPEN VERTICAL VOLCANIC CONDUITS

ALGAR DO CARVÃO, TERCEIRA, AZORES APPEARS ASTRONAUT-FRIENDLY

THRIHNUKAGIGUR (ICELAND) IS NOT ASTRONAUT-FRIENDLY

OTHER PSEUDOKARSTIC POSSIBILITIES



PHOTOGRAPHER UNKNOWN

ROCK HOUSE CAVE, OHIO, A TALUS CAVE

PIPING CAVE NEAR DEATH VALLEY, CALIFORNIA PHOTO BY B. SZUKALSKI

ENTRANCES, ABLATIONAL CAVE, WASHINGTON STATE

"WALK-IN" LITTORAL CAVES ARE COMMON ON SHORES OF SOME LARGE TERRESTRIAL LAKES AND OCEANS, AND ESPECIALLY SHOULD BE SOUGHT ON MARS. ADDITIONAL ASTRONAUT SHELTER MAY BE PROVIDED BY MARTIAN TALUS CAVES, PIPING CAVES IN POORLY CONSOLIDATED MARTIAN CLASTICS, AND ABLATIONAL CAVES IN MARTIAN GLACIERS. ALL HAVE TERRESTRIAL ANALOGS. LAVA TUBE CAVES CURRENTLY ARE EXCLUDED BECAUSE OF SHARP-EDGED BASALT ROCKS CHARACTERISTICALLY OUTSIDE ENTRANCES.