THE DOUBLE CALDERA OF ALBA PATERA ON MARS; Jouko Raitala and Kauko Kauhanen, Department of Astronomy, University of Oulu, Oulu, Finland

The Alba Patera volcano is one of the oldest volcanoes of the greater Tharsis area. Its main part measures approximately 1600 km across but it is only 3 to 5 km high (Carr, 1980). There are not any other volcano like Alba Patera on Mars (Greeley and Spudis, 1981) but there is a controversy in the timing of the activity of Alba Patera, however. Although it is considered to be very old (3.8 - 3.2 x 10^9 yrs by Neukum and Hiller, 1981; 2.3 - 1.5 x 10^9 yrs by Plescia and Saunders, 1979) there are several groups of relatively young (- 0.5 x 10^9 yrs) lavas which both cover the middle part of Alba Patera and reach far into the peripheral areas.

The summit caldera complex of Alba Patera measures 150 km across. It consists of two major calderas and both of these main calderas have features indicating that the caldera development has undergone long-term processes. Although Alba Patera is not a typical shield volcano its calderas are shield volcano-like (Wood, 1984).

The rim of the larger western caldera is partly buried by extrusives. It displays, however, at least six different caldera development phases (Cattermole and Reid, 1984). The western rim seems to be the youngest part of this main caldera. Outside the rim there is an arcuate fault with a lava channel, possibly indicating the most present caldera-forming activity. In the middle northern part of the larger caldera there is also a circular ridge surrounding a depression. It may, of course, be a lava-buried impact crater, but more evidently it is the main summit vent of the volcano. Owing to the volcanic nature of the Alba Patera this vent explanation is more probable.

The smaller eastern main caldera measures approximately 65 km by 45 km and is located in the southeastern corner of the main western caldera. It consists of several structural components the bottom of which are on different levels. The most present and deepest pit seems to be the southeasternmost subcaldera. The rim of the smaller main caldera is smooth and it is broken only in a few places in northeast. There has, however, been some landslides which have changed the rim profile (A).

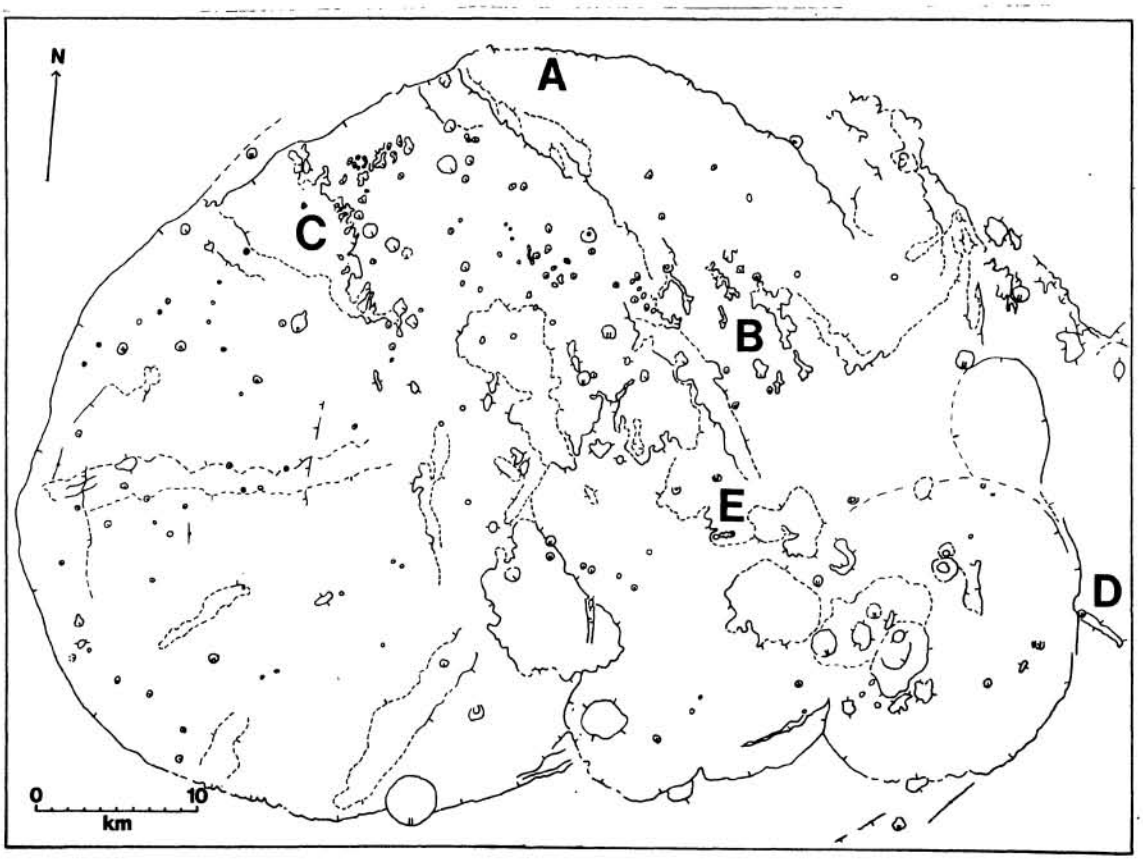
On the bottom of this more present main caldera there are several different volcanic and tectonic features: domes, lava intrusions, lava lakes, faults, ridges, and craters. Aeolian activity has not covered the bottom very much. Volcanic domes are 0.3 to 3 km wide and the largest domes are located in southeastern subcalderas. Because these areas are probably also younger than the other parts of the caldera, the domes may be related to the last active period in this caldera.

There are more low domes in the middle part of the smaller main caldera. They are less distinct in their shape, possibly due to volcanic and tectonic cumulation and erosion after their formation. Some may be laccolithic intrusions which dome their roofs. Cattermole and Reid (1984) described them to be caused by series of lava lakes of different ages where lava levels of some lakes have remained relatively high for some reason. Adjacent to lava lakes there are also small volcanic cones some of which have a small crater on the top. The rim of the crater is usually broken, giving the impression that the crater is elongate. Even if so many small craters are of impact origin most of these craters in the smaller of the two major calderas of Alba Patera seem to be caused by volcanic extrusions.

There are also several irregular depressions in the area, possibly indicating the existence of dried lava lakes (B). One depression is relatively large having a flat bottom (C). Its northern border, even if broken, is well exposed but the southern border is not so distinct. This depression becomes more narrow closer to the center of the caldera and it finally becomes a rille which begins in a small crater, resembling a lava channel and its vent. There is also a crater-chain rille (E) which resembles a queue of low volcanic cones. In the rim of this caldera a small lava flow begins from a crater (D).

Several distinct subcalderas indicate the fluctuation of the volcanic and caldera-forming activity along the time. Even if the main calderas were formed by collapsing of the uppermost summit by withdrawal of the magma it has not been a straightforward process but changed several times during the last development of Alba Patera. Several mare ridge-like ridges in both main calderas have extensions also outside in the eastern and western rim area indicating the possibility that the whole central Alba Patera area may have been compressional due to the lava load and withdraval and cooling of the magma in the main magma chamber (Wood, 1984).

Refs.: Carr, M.H. (1980) Space Sci. Revs. 25: 231-284. Greeley, R. and Spudis, P.D. (1981) Rev. Geophys. Space Phys. 19: 13-14. Cattermole, P. and Reid, C. (1984) Lunar Planet. Sci. XV: 142-143. Neukum, G. and Hiller, K. (1981) J. Geophys. Res. 86: 3097-3121. Plescia, J.B. and Saunders, R.S. (1979) Proc. Lunar Planet. Sci. Conf. 10th: 2841-2859. Wood, C.A. (1984) J. Geophys. Res. 89: 8391-8406.



Sketch map of the eastern (and smaller) main caldera of Alba Patera on Mars. Caldera rim (solid and broken lines with barbs downhill), impact craters (rings with two barbs inside), volcanic craters (rings with one barb inside),volcanic cones (double rings), domes (closed solid or broken lines with barbs outside), faults (solid lines with barbs) and lineaments (lines with filled circles) are indicated.