STRATIGRAPHY AND DEVELOPMENT OF THE HECATE CHASMA DEFORMATION AREA ON VENUS. M. Aittola and J. Raitala. Astronomy, Dept. of Physics, Univ of Oulu, 90570 Oulu, Finland (maittola@paju.oulu.fi, jouko.raitala@oulu.fi).

Magellan radar image C1-MIDRP.15N249;1 covers an area which is part of the Hecate Chasma zone between Beta and Atla Regions. The main fracture belt cuts through the high topography in the middle of the study area. Tectonic structures (faults, grabens etc.) close to the Hecate Chasma zone are mostly extensional and closely related to the main zone and the whole zone is interpreted to be an extensional one [1]. The uppermost surface as well as local coronae are rather young within this kind extensional area in general [2]. The number of coronae within such an area is higher than in average [3]. The age and development can be studied by means of several approaches. Strafigrafical comparisons are, however, the most effective when trying to find relative ages and formation phases of the surface formations. Especially this is true when studying this kind restricted area with only a few impact craters. The mean Venusian impact crater density of $2{,}0*10^{-6}km^{-2}$ [4] allows age studies only over larger areas and the method can not be used within one C1-MIDR image area.

There are found 16 different stratigraphic and structural units from within the Cytherean surface [5] which can be further combined into three main age categories the examples of which may be such old plains as Pwr, young plains like Ps, Pl and old surface units like RB, F, Tt [6]. Comparisons between various surface units and their coverage and age relationships allow conclusions of the formation history of each individual area studied. By taking a certain common reference unit (Pwr) to be of equal age all over the planet the ages of all other units can be found relative to that stratigraphic marker [7].

The stratigraphic and structural units observed within the study area in the general age order from youngest to oldest are:

- Smooth plains/lobate plains (**Ps/Pl**) cover all other structures and units.
- Rift-associated fractures (**Fra**) are connected to the formation of the main fracture zone. They cut through the Pwr unit in the NE part of the area. The tectonic zone in the western part of the image is interpreted to be similar to the unit Fra. The structures found in the SW part of the image, probably caused by same stresses than Fra, are younger than the fresh-looking impact crater.
- This young impact crater and adjoining dark area (**Cpd**) is considered to be one of the youngest surface units [5]. Within this area the dark unit (Cpd) is, however, older than certain tectonic fractures (Fra) and the youngest lava flows (Ps). This is a good indication that the area has been tectonically and volcanically active rather late in the history of Venus.
- Plains with wrinkle ridges (**Pwr**) cover wide areas in the upper and lower part of the image within the outern border area of the actual Hecate Chasma zone.
- On the southern side of the Hecate Chasma zone there is a corona chain which is bordered by strong ridge zones (**RB**). The compressional central part (RB) of the topographically high middle area is probably of the same origin. These compressional structures are both covered by the Pwr unit which is older than the main zone fractures. Both RB and coronae are thus older than the main fracture zone.
- Densely fractured terrain (**Pdf**) consists of individual remnants or islets among plains units. Within this area these islets have mostly N-S and NE-SW directed fractures. To the east of corona which is located at 16°N/251,5°E this unit is older than Pwr and structures belonging to the southern corona chain. There are also densely fractured terrain (Pdf) covering a (multiple) corona located at 21°N/244°E and to the south of corona located at 16°N/251,5°E. Both these areas include numerous volcanic edifices.
- Old deformed unit (**Tt**) is found only to the north of the main fracture zone. All other units seem to be younger than these small tessera areas.

The formation of corona structures is interesting because it can not be connected to any certain period of time. One of the oldest corona at 21°N/244°E was almost covered before the formation of the Pwr unit. On the other hand, a younger corona like the one at 39°N/256,5°E continued its development long time after the emplacement of the Pwr unit. It is interesting to note that most of the coronae observed within this area are much older than the Pwr unit. Thus the coronae of the study area are, in general, not younger than anywhere else.

Geological history

The oldest units of the area are Tt and Pdf together with oldest coronae, like that one which is located at 11°N/244°E. The RB unit and a corona chain on the southern side of the Hecate Chasma are also formed before the Pwr unit, but they are younger than Pdf unit. The central high area is divided into two parts in the middle by the main fracture zone. The eastern part actually consists of a corona the centre of which is located at 16°N/251,5°E. On the eastern side of the corona its structures are covered by Pwr. There are also found the main fracture zone units (Fra) which are younger than Pwr. It is thus the most probable that this high topography area, which reaches higher than the mean planetary radius (MPR), has prevented the direct fracture penetration through the uppermost crust and has deflected the main fracture zone to run through, or along, the lower northern side of the bulge where the crust has probably been weaker.

These units and most of the coronae of this area were formed before the Pwr unit. The only units which are younger are Cpd, Ps/Pl and Fra. The Cpd unit is older than Fra as found from the age relationships when studying the small impact crater and its dark aureole which are cut by the Fra structures. These tectonic Fra structures were later covered by the youngest Ps/Pl units.

Age	older than Pwr				<- ->	younger than Pwr			
	Tt	Pdf	RB	Cor1	Pwr	Cor2	Cpd	Fra	Ps/Pl
North	x	x	x	x	x	x	x?	x	x
South	x	x	x	x		x	x	x	

The table provides the time sequence of the main stratigraphic and structural units separately for the northern and southern side of the Hecate Chasma zone within the area studied. The oldest units are on the left and youngest ones are on the right. Special corona-related unit is divided into two part because there has been some corona formation both before (Cor1) and after (Cor2) the emplacement of the Pwr unit.

The geologic history of the area is rather similar to what is proposed for the general stratigraphic column of Venus [5]. The most important observation which conflicts with this stratigraphic model is that the main Hecate Chasma fracture zone is rather young. This implies that also its tectonic structures (Fra) and lava fields (Ps/Pl) are younger than similar structures in average. The main difference in the geologigal history between the areas to the north and south from Hecate Chasma is that old tessera (Tt) units and young coronae (younger than Pwr) are missing from the southern side.

This kind stratigraphic approach is the most valid in an environment with clealy distinguished periods of volcanic activity. Thick main lava units with varying ages can be mapped rather exactly by comparing their outlook and overlapping relations. The use of effectivity of tectonic deformations in finding relative ages for particular surface units is, however, not as unambiguous. Especially within this kind area with a clearly defined period of time of strong tectonic activity along the Hecate Chasma zone in the middle, the age determination of two otherwise similar units may depend on how close or far they are from the center of tectonic activity or how effectively they are deformed by tectonic forces. If this possibility and its consequences are taken into the account in referring to a certain deformed unit the time sequence [5, 7] can be put into the right context. Actually, in stead of stratigraphic timing we should speak of event timing.

References: [1] Hamilton V.E. and Stofan E.R. Icarus 121, 171-194, 1996; [2] Johnson C.L. and Solomon S.C. LPS XXVII, 607-608, 1996; [3] Stefanic M. and Jurdy D.M. JGR 101, 4637-4643, 1996; [4] Schaber et. al JGR 97, 13.257-13.301; [5] Basilevsky A.T. and Head J.W. EMP, 66, 285-336, 1995; [6] Pronin, A. A. LPS XXVIII, 1147-1148, 1997; [7] Basilevsky A.T. LPS XXIV, 67-68, 1996.