TECTONICS OF SOUTHWESTERN AUDRA PLANITIA ON VENUS FROM MAGELLAN DATA: EVIDENCE OF UNDERTHRUSTING; T. Törmänen and J. Raitala, Department of Astronomy, University of Oulu, SF-90570 Oulu, Finland

Introduction. Audra Planitia is a plains area situated to the south of eastern Fortuna Tessera and NE of Laima Tessera. The area was previously studied from Venera 15/16 data and proposed to be an area of extensional rifting [1] or complex compositional tectonics [2,3,4]. Audra Planitia is bordered in the SW and partly in the south by a large ridge belt (Fig. 1a, point A) with a distinct eye-shaped plains area inside it. This ridge belt was proposed to have formed in a generally N-S directed compression [2,3]. We have studied Audra Planitia area and especially its southwestern parts using Magellan radar images and topography data. Results presented here show that the bordering ridge belt is a probable site of deep underthrusting and crustal folding in a NE-SW directed compression.

Characteristics of structural features of southwestern Audra Planitia. Southwestern Audra Planitia is characterized by N-S directed, two to tens of kilometers long, 0.2-2 km wide linear or slightly sinuous ridges (Fig. 1a, point D). These ridges resemble wrinkle ridges on the plains of the Moon and Mars. There are four separate higher-standing ridge belts east of the main concentration of the N-S ridges (Fig. 1a, point C). Individual ridges are 0.3-2 km wide and have lengths of several kilometers up to ~100 km.

The southwestern and southern border of the plain is defined by a ~1200 km long arcuate ridge belt with a maximum width of 210 km. This unnamed ridge belt has two main branches with a low-lying eye-shaped plain between them (Fig. 1a, point D). The morphology of the small plain is similar to the SW Audra Planitia. The ridge belt is composed of linear or arcuate ridges, which follow the trend of the ridge belt and have widths of ~1-5 km, spacings of 4-20 km and lengths varying from several kilometers to ~75 km. Ridges have distinct slopes and resemble fold belts. There are a few extensional fractures west and east of the small plain. Most of these fractures are oriented parallel to the ridges and only few cross-cut them. The main part of the ridge belt has a WNW-SSE orientation. Further east the ridge belt turns to ENE and narrows. Its ridges become narrower, shorter and more closely spaced and disrupted. There is a place in the outer edge of the ridge belt where N-S oriented linear ridges have been disrupted by the ridges of the ridge belt (Fig. 1a, point E). The N-S ridges are visible as short segments between longer ridges. This shows that ridge belt formation has postdated formation of the plains ridges.

Topography. Topographically the ridge belt is high, ~1-1.6 km higher than the southwestern Audra Planitia. There is a ~1-1.5 km high north-facing scarp at the northern side of the ridge belt (Fig. 1, altimetric profiles A-A', B-B', C-C', small arrows). Audra Planitia slopes down from north to south towards the ridge belt. The slope is generally linear. There is some evidence of a shallow foredeep just north of the scarp (small triangles at altimetric profiles).

The eye-shaped plain is bounded by scarps in the north and south (profiles A-A', B-B'). The southern scarp is steeper than the northern one (height of the southern inner scarp is ~1.6-2.5 km). The surface of the small plain area slopes to S/SW continuing exactly the topographic trend of the western Audra Planitia. There is a narrow deeper area just before the southern scarp where topography drops several hundred meters, in some points over a kilometer (Fig. 1b, larger arrows). This deeper area forms a linear inner foredeep before the southern scarp.

The larger-scale topography of the main ridge belt is rather flat. The northern branch of the main ridge belt slopes slightly down towards the inner plain and the bordering scarp. To the east the ridge belt and its bordering scarp become lower. The south-sloping trend of Audra Planitia remains, however. The shallow foredeep is also visible in the altimetric profiles over eastern part of the ridge belt (profile C-C').

Interpretations. The orientation, morphology and resemblance to wrinkle ridges show that the N-S oriented ridges were formed in regional E-W directed compression, which caused folding and buckling of the plains crust. This agrees with results presented in [2]. The smaller ridge belts were formed in NE-SW directed compression [2].

The morphology of the ridges of the large ridge belt show that they were formed by faulting and folding [3,5]. Because short segments of linear plains ridges can be seen on the outer folds of the ridge belt, the ridge belt was formed by deformation and shortening of the plains crust of SW Audra Planitia. The presence of major scarps, down-sloping topography of Audra Planitia and the small plain, and presence of foredeep features at the base of the north-facing scarps point to deep underthrusting process in NE-SW directed compression.

Situation resembles in some ways mountain belts around Lakshmi Planum, which have been proposed to have formed in crustal shortening and underthrusting [6,7]. In this case the process has not resulted in mountain belt formation, maybe because of younger age or smaller horizontal stresses involved. The occurrence of the ridge belt adjacent to tessera area and morphology of its ridges are also similar to ridge belt adjacent to northern Ovda Regio, which is interpreted to be compressional fold belt [8]. Underthrusting has moved to NE resulting in formation of the remnant eye-shaped plain. The topographic relations and structural features along the southern border of Audra Planitia against Dekla Tessera area indicate shallower underthrusting in N-S direction. The compression and underthrusting at the SW border of Audra Planitia has also contributed to the deformation of Kamari Dorsa tessera block and ridge belt terrain to the south of Audra Planitia.

Conclusions. The ridges of the SW Audra Planitia have formed in an earlier E-W directed compression and adjacent ridge belts in compression with a NE-SW direction. The major ridge belt bordering Audra Planitia against Laima Tessera and Kamari Dorsa areas has formed in deep underthrusting and crustal shortening in NE-SW direction. The ridge belt - Audra Planitia area is an example of a pattern of narrow, deformed zones and less deformed, comparatively stronger crustal blocks, which are apparently typical to Venus [9].

Figure 1. a) Sketch map of Western Audra Planitia. b) Altimetric profiles. Zero elevation is planetary mean radius 6052 km.