50 Ma OLD TESSERAE IN SOUTH-EAST THETIS REGIO? R. C. Ghail, T.H. Huxley School, Imperial College, London, SW7 2BP. R.Ghail@ic.ac.uk.

Introduction: The highland terrain in south-east Thetis Regio, 16°S, 134°E (fig 1), consists of a series of thrust faults and conjugate graben that would usually be classified as tesserae. Close inspection reveals that this small area of tesserae is younger than the adjacent plains, in contrast to most regions of tesserae [1]. Further examination reveals that the area may be modelled as a simple orogeny resulting from east-west compression between two rift systems. Two structural belts are distinguished, the foreland ridge-and-trough terrain, and the central plateau. These are modelled as a fold-and-thrust compressional belt and a basin-and-range type plateau collapse, respectively, similar to that proposed for the Himalayas and the Tibetan plateau [2]. The driving force for this compression may be the extension in the rift systems Vir-Ava Chasma, to the north, and Diana Chasma, to the south-east.

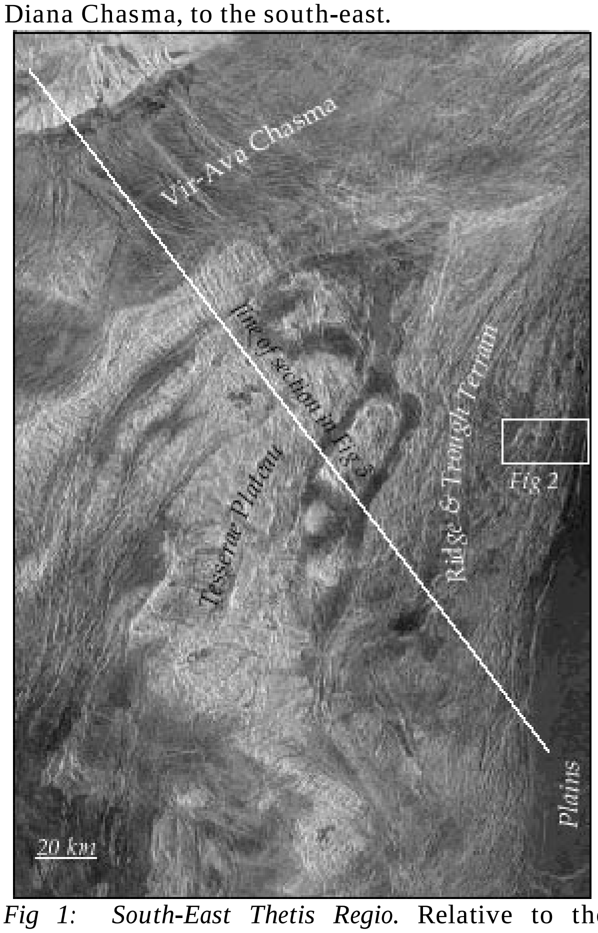

Fig 1: South-East Thetis Regio. Relative to the plains, Vir-Ava Chasma is at ~ -1 km, the ridges are at ~2·5 km, and the tesserae plateau is at ~4·5 km altitude.

Structural Development: In the central tesserae plateau the earliest structures are north-south striking (015°N) thrust faults. This thrusting has led to crustal thickening, but some of the 4 km high topography of the central belt may be due to bouyant uplift following sub-crustal delamination. Post-dating the thrusts are a conjugate set of graben (033°N and 155°N) that most likely result from the collapse of the plateau following buoyant uplift, as in Tibet [2]. The stress field associated with the conjugate set of graben is the reverse of the stress field in the thrust belt, indicating that the graben are related to the collapse of the plateau within the same regional stress field. Major graben basins are as much as 5 km below the level of the surrounding terrain and are filled by flood lavas that may arise from decompression melting below the plateau. They are extruded into the sediment-free troughs, in contrast to Earth where intrusion into metamorphosed sediments is more common. Contemporaneous with the collapse of the central system was the development of further north-south (006°N) thrusts to the east, indicating that the thrust front migrated eastward into the adjacent plains. Thrusts have clearly developed from within the plains (fig 2), indicating that this region of tesserae is composed of plains unit material and is younger than them.

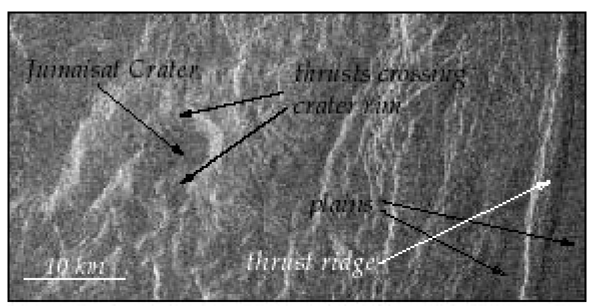

Fig 2: Jumaisat Crater and Thrust Ridges. The deep flat-floor, bowl-shape of the crater indicates that it formed in pre-existing ridge-and-trough terrain, but note that several of the thrusts cut the crater rim and ejecta. This indicates that tectonic activity continued after the crater formed. The thrust ridges themselves are developed in the plains unit, beyond the main ridge-and-trough terrain. Stereo mapping demonstrates that there is no onlapping relationship between the plains and the thrusts and that the thrusts are therefore younger.

Material in the foreland ridge-and-trough terrain has not been uplifted to as great an elevation as the central belt (the mean altitude is 2·5 km), implying that sub-crustal delamination has not occurred. Whether compression is continuing in the thrust belt is unknown but it is possible that here too sub-crustal delamination will occur with a concomitant eastward migration of the thrust front into the plains.

Fig 3 illustrates the proposed stages in the formation of south-east Thetis Regio. Upwelling and moderate extension at the two rift systems generates a compressive stress in the intervening plains lithosphere (a). This lithosphere breaks and thrusts develop between the two halves (b), thickening the crust and accommodating the extension in the rifts. Later (c), the underthrust lithosphere destabilises and delaminates. Isostatic rebound buoys up the thrust belt into a plateau, which then collapses under gravity along conjugate graben. Decompression melting occurs in the mantle beneath the plateau, flooding the graben floors with lava. Meanwhile, new thrusts develop in the plains between the plateau and the rift, accommodating both the extension in the rift and the collapse of the plateau.

Note that, while horizontal forces are implied, oceanic-type plate tectonics is not. The system is more analogous to continental tectonics.

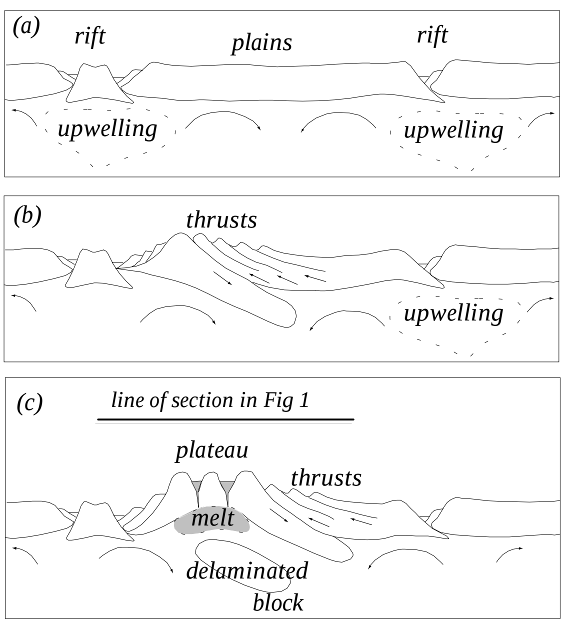

Fig 3: Orogenic Evolution. Schematic illustrations, not to scale. See text for details.

Age and Rate of Tectonism: Unusually, wind erosion is prominent across the region, particularly in the south. Westerly winds have rounded the western margins of the plateau, producing tear-drop shaped hills. Reflectivity data [3] imply that the high reflectivity material from the plateau surface has been deposited for several hundred km across the eastern plains, increasing the reflectivity of those plains relative to the planetary norm. Together with the development of thrusts within the plains, this pattern of erosion and deposition confirms that south-east Thetis Regio is younger than the surrounding plains, in contrast to the findings of [1]. How much younger is not clear; the central plateau is analogous to Tibet, which is less than 25 Ma old, but without knowing the rate of horizontal compression or the rate of erosion, the usefulness of the analogy is limited.

The only crater in the region is Jumaisat (see Fig 2), a dark-halo crater that is 50±50 Ma old [4,5]. Although it clearly impacted into the ridge-and-trough terrain, its rim has been disrupted by the ridges, indicating that thrusts were still active at the time of the impact. The age of the ridge-and-trough terrain, and most likely the age of the plateau formation, is therefore 50±50 Ma, implying a rate of tectonism about half that of Earth.

Implications: A simple continental orogenic belt model can be successfully applied to south-east Thetis Regio. The necessary horizontal compressive stress can be supplied by two rift systems. This region demonstrates that tesserae are not everywhere the oldest unit and, in this case, may have formed within the recent past.

References: [1] Basilevsky A.T. and Head J.W. (1998) *JGR, 103,* 8531-8544. [2] England P.C. and Houseman G.A. (1989) *JGR, 94,* 17,561- 17,579. [3] Ghail R.C. (1999) *LPSC XXX,* (this issue). [4] Zahnle K. and McKinnon W. (1996) *Bull. Am. Astron. Soc., 28,* 1119. [5] Strom R.G. et al. (1994) *JGR, 99,* 10899-10926.