Tessera terrain consists of radar-bright material cut by at least two sets of closely spaced structural features, generally intersecting at high angles [1]. Previous studies have detailed the diverse structural styles of tessera, and have inferred sequences of deformation of specific large areas of this terrain [2,3,4,5,6]. Generally, tessera is the oldest stratigraphic material at any given locality [7]. Embayment relationships indicate that the formation of specific blocks of tessera occurred before the emplacement of surrounding plains material. However, evidence has been found for post-regional plains uplift of tessera [8, 9], with possible deformation and accretion of plains material along the margins of some tessera blocks [10]. Another recent study has indicated a history of polyphase deformation within western Fortuna Tessera [11].

Tessera terrain is found within the highland plateau of Ishtar Terra, on elevated crustal plateaus, and in the form of isolated blocks surrounded by stratigraphically younger regional plains material [12]. Examination of an unnamed tessera block in the Vellamo Planitia quadrangle (V12) reveals evidence of episodic pre-regional plains tessera deformation. Located at 31°N, 124°E, this block is approximately 470 km x 600 km, with its long axis oriented north-south. It can be divided into structural domains on the basis of the scale and morphology of structures present. For the purpose of this analysis, stratigraphic relationships between tessera, late-stage graben, and intratessera plains materials will be examined only in the northernmost structural domain of the unnamed tessera block, where definitive evidence demonstrates the polyphase tessera deformation.

The northernmost structural domain, located between latitudes 124.5°N-128°E and longitudes 31°N-33.5°N, is approximately 200 km x 275 km, with its long axis oriented east-west. Structural features present are ridges, troughs, graben, and intratessera basins. The major structural fabric consists of straight, arcuate, and anastomosing linear elements, of both fine and broad-scale. The linear elements range in orientation from N64W to N40E. They are spaced from .6 km to .3 km apart, are 3 km wide to below the resolution of the radar, and range in length from 2-19 km. Troughs, which often parallel the trend of the linear elements, are present locally.

The northernmost domain also includes numerous graben which crosscut each other in complex patterns. These graben range in length from a few km to 450 km, and range in width from .5 km to 5 km. The largest of those occur in two sets: one set trends east-west +/- 30°; the other set defines an east-concave arc, with trends changing from NNW at the northern limit of the domain to NW at the southern limit. One exceptionally long (450 km) member of this set continues curving to an east-west orientation at the southeast limit of the domain. Other (mostly small) graben have diverse trends, and thus do not belong to either of these sets. Near the contact between tessera and surrounding regional plains there is evidence that the graben continue underneath the regional plains material. This includes aligned graben segments within isolated fragments of tessera material north of the main block of tessera, and the subdued trace of the margins of one graben on the plains. Most of the large graben in the northernmost domain contain intratessera plains material with similar radar backscatter and with backscatter similar to that of the surrounding plains.

In a number of localities, the faults that are bounding the grabens crosscut not only other graben faults but also the intratessera plains within these graben. It is thus possible to establish a stratigraphic sequence which reveals the episodic nature of graben formation and intratessera plains material deposition. An excellent example involves three graben in the northwestern part of the defined structural domain, located in a region from 32.5°-33.3°N and 124.5°-
125.5˚E. The smallest of these (graben A) trends NW, and is approximately 75 km long and .5 km wide. A larger graben (graben B) trends NNW, and is approximately 265 km long and .5-3 km wide. Another large graben (graben C) trends NE, and is approximately 100 km long and .5-1.5 km wide. Graben A contains no fill, but crosscuts both grabens B and C and the intratessera plains materials within each of them. Graben A is truncated at the contact between tessera and regional plains. In turn, graben B crosscuts graben C and its intratessera plains material. This sequence implies two intratessera plains units of different ages within the two larger graben, both of which are crosscut by a younger graben; that is, there are two depositional and three faulting events, all of which are older than the regional plains surrounding this tessera block.

The tessera material in the northwestern part of the northernmost domain is characterized by closely spaced linear features trending from N5W to N30W. Most of the elements defining this fabric are cut by the large grabens and buried by the intratessera plains within these graben. However along the southwestern half of graben C the intratessera plains are crosscut by some of these fabric elements. This indicates that tessera deformation continued after the intratessera plains material in graben C was emplaced.

It is important to note that without the crosscutting relationships apparent here one would likely assume that all the intratessera plains are the same age, based on their similar radar backscatter and apparent continuity with each other. Likewise, without the intratessera plains, it would not be possible to document multiple episodes of tessera deformation. These results suggest that we must be cautious about assuming simple depositional and deformational histories for tessera blocks lacking the evidence present here.