Venus’ Ishtar Terra: Topographic Analysis of Maxwell, Freyja, Akna and Danu Montes

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Abstract

Principal component analysis offers an independent and objective mode of comparison of the venusian mountains with terrestrial counterparts with known tectonic origins. Comparison can be made with other topographic features on Venus, such as chaotoma. We use topographic profiles to compare the venusian montes of Ishtar Terra using principal component analysis (PCA). Comparing the profiles may help us in understanding the processes involved in the formation of the montes.

Introduction

Western Ishtar Terra consists of a central plateau of smooth plains (Lakshmi Planum) surrounded by four mountain ranges (Akna, Freyja, Maxwell, and Dana Montes [Fig. 1]) and regions of tesiern outboard of these mountains. Elevations in Lakshmi Planum range from ~2.5 to 4.0 km above mean planetary radius (6051.9 km)[1]. Critical to the understanding of the tectonic style of Venus is the origin of the major mountain ranges on western Ishtar Terra.

We use topographic data from the Magellan mission (1990-1994) to Venus. Using this dataset we extract profiles for the four Montes (Maxwell, Freyja, Akna and Dana) of Ishtar Terra.

Procedure

We construct principal components using a covariance matrix, regressed from the dataset [Fig. 2]. The principal components assess the degree of similarity and variability of shapes of the average profiles [Fig. 3 & 4], offering an independent and objective mode of comparison [14,15].

The principal components of the Ishtar Terra montes shows that the first PC is marked by a steep decline and the second PC by a central upthrust. These characteristics and the PCA technique provide a quantitative avenue of comparison of the montes. The first component represents a generic or archetypal feature never exactly found. The second and third components describe principal modes of variation.

The ternary diagram to the right gives a visual representation of how much the montes are to each other. The points corresponding to each feature tend to scatter and do not show any similarity among the montes.

Future Work

The mountains of Venus will be compared with Earth’s mountains of known tectonic origin. Some possible analogues:

- Himalayas – Active Continental Collision
- Andes – Active Subduction (Oceania)
- Urals – Extinct Continental Collision

Results

The decomposition of the principal components of the Ishtar Terra montes are shown in the first three principal components.

In this study, we address this question with the analysis of Magellan topographic data for quantitative comparison of Venus’ four mountain chains: Maxwell, Freyja, Akna and Dana. Patterns in topography may provide clues to the dynamics forming these Venusian orogenic belts.

References


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