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Forward mechanical modeling of thrust faults on Mercury

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Abstract

In this work we use a mechanical dislocation program to analyze the fault geometries and depths associated with a group of prominent lobate scarps in Mercury. We obtain depths of faulting of 30-40 km. This range overlaps with those previously obtained for Discovery Rupes and for two unnamed lobate scarps.

1. Introduction

Mercury's most characteristic tectonic features are lobate scarps, which are interpreted to be the surface expression of thrust faults and provide important clues about the geological and thermal history of this planet. Indeed, the large depth of faulting deduced from modeling lobate scarps topography suggests that it represents the crustal brittle-ductile transition, which in turn permits us to put limits on the thermal and mechanical properties of the lithosphere at the time when faulting occurred. Here we use a mechanical dislocation program to analyze the fault geometries and depths associated with a group of prominent lobate scarps in Mercury.

2. Method and Results

Topographic profiles across lobate scarps are being derived from Earth-based radar altimetry data obtained by the Arecibo antenna [1]. We use the forward mechanical dislocation program Coulomb to predict the surface displacement associated with faulting [2], [3]. Comparison of the modeled relief above a given fault with topographic profiles derived from Earth-based radar altimetry data permits the identification of admissible fault dips, depths and displacements. The best fits to the topography across lobate scarps are obtained by using depth of faulting of 30-40 km.

3. Conclusions

Our results constrain the brittle-ductile transition depth to 30-40 km, which is consistent with the faulting depth obtained for Discovery Rupes by Watters et al., 2002 [4] and for two unnamed lobate scarps located near the equator at 64.7º E and 59.3º E [5]. This could suggest that the strength of the lithosphere of Mercury was relatively homogeneous at the time when those scarps were formed, although the relative timing of formation of the diverse features needs to be carefully addressed.

References

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