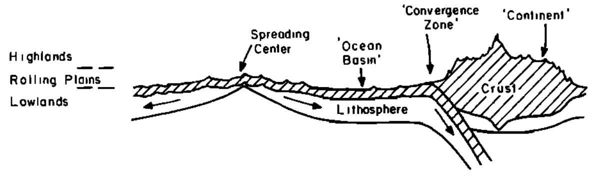

Fig. 2. A schematic illustration of the plate recycling hypothesis for lithospheric heat transport on Venus. The rolling plains (0 to 2 km elevation with respect to the planetary modal radius) and lowlands (0 to −2 km) are analogous to terrestrial ocean basins and include spreading centers and convergence zones not currently resolvable from altimetry or imaging data. The highlands (2 to 11 km elevation) are analogous to terrestrial continents.

relief at Venus conditions and that such a ridge on Venus could not be detected from Pioneer Venus altimetry given the 200-m standard error for these data [*Pettengill et al.*, 1980]. By the plate recycling hypothesis for Venus, the rolling plains and lowlands provinces (as defined by *Masursky et al.* [1980]) should be the Venusian analogs to terrestrial ocean basins. Altimetric and imaging data from rolling plains and lowlands areas must be obtained at resolutions superior to those of data currently available in order to search for the predicted extensive system of fast spreading ridges and thereby to provide a rigorous test of the plate recycling hypothesis for Venus.

Assessment and Implications of the Hypothesis

We find no convincing argument to reject at present the hypothesis that some form of plate recycling dominates lithospheric heat transfer on Venus. This conclusion does not mean that plate tectonics can presently be demonstrated on Venus or that we may not at some future date obtain improved information on the Venusian surface or interior that will allow the question to be firmly resolved. Rather, the conclusion demands that at our present level of understanding, the hypothesis that plate recycling is important for heat flow on Venus should continue to be rigorously tested against available geological information.

The lithospheric recycling hypothesis for Venus is illustrated schematically in Figure 2, and some of the implications of the hypothesis for the surface characteristics of the planet are listed in Table 1. As on earth, volcanic activity on Venus should be extensive by this hypothesis and should be concentrated at divergent plate boundaries. Intraplate volcanic activity may also be present. Volcanism at subduction zones may be minor at present if no free water or hydrous phases are subducted. Tectonic activity should be widespread and dominated by the large-scale horizontal motions and mutual interactions of the plates. As noted above, however, the specific physiographic characteristics of many tectonic features at plate boundaries may differ from those on earth because of the greater surface temperature and negligible surface water on Venus. Theoretical models are needed for the expected form of such features at Venus-surface conditions.

By the plate recycling hypothesis, the rolling plains and lowlands provinces are analogs to terrestrial ocean basins in terms of formative process, crustal composition, and geologically youthful age. The spreading centers are expected to be characterized by rapid spreading rates and modest relief in comparison to earth. The Venus highlands may be analogs to terrestrial continents, though whether the analogy extends to composition or simply to crustal thickness is uncertain. The surface ages of highland geologic units on Venus may be considerably greater than the ages of units in the plains and lowlands. As with terrestrial continents, highland lithosphere should have greater buoyancy than the lithosphere beneath plains and lowlands and should therefore be more difficult to subduct. Mountainous terrain should, by this hypothesis, form by the collision of highland blocks (Himalayan analog) or at the locus of subduction beneath highland lithosphere (Andean analog). Both highland regions in general and mountain belts in particular will be modified as they age. Because of the high surface temperature and negligible water on Venus, viscous relaxation may be a more rapid process than weathering and erosion for reducing highland relief, in contrast to earth.

LITHOSPHERIC CONDUCTION

The dominant mechanism for lithospheric heat transport on the smaller terrestrial planets is conduction through the single global lithospheric shell. That lithospheric conduction dominates the planetary heat loss on Venus has been an implicit or explicit element of a number of recent discussions of the internal and surface evolution of Venus [*Schaber and Boyce*, 1977; *Warner*, 1979; *Anderson*, 1981; *Phillips et al.*, 1981; *Arvidson and Davies*, 1981].

If the global heat loss on Venus is delivered to the surface

TABLE 1. Implications of End-Member Hypotheses for Lithospheric Heat Transport on Venus

Surface Characteristics	Plate Recycling	Lithospheric Conduction	Hot Spot Volcanism
Volcanic activity	extensive; activity dominantly at divergent boundaries	minor	extensive; active centers nearly cover surface
Tectonic features	widespread; dominated by plate interactions	possibly extensive deformation of thin lithosphere	primarily vertical tectonics
Ages of surface units	rolling plains and lowlands geologically young ($< 10^8$ years)	unconstrained; ancient impact features may be preserved	much of surface young ($\lesssim 10^7$ years)
Nature of mountain belts	products of plate convergence	anomalously thick crust and lithosphere	volcanic constructs
Nature of highlands	analogs to terrestrial continents	thickened crust and lithosphere	thickened volcanic crust
Nature of rolling plains and lowlands	analogs to terrestrial ocean basins	thinned crust and lithosphere	'normal'-thickness volcanic crust