morphologies, (2) contemporaneous ages of all fractures, and (3) location of a smooth impact scar at the center of the fracture system.

Model 3: Isostatic uplift (Figure 6c). This model envisions isostatic, domal uplift over a developing mantle density anomaly. Deformation of a thin lithosphere overlying an isostatic uplift was described in detail by *Sleep and Phillips* [1985] and was proposed as the origin of system II furrows by *Murchie and Head* [1987] and *Murchie et al.* [1988]. A low-density anomaly could develop in a convecting mantle as a thermal anomaly such as a rising convection current, or as a chemical anomaly such as an enrichment of ice content relative to the content of intermixed silicate. Predictions of the model in the absence of externally imposed stresses include (1) proximal, radially arranged, extensional troughs and distal, concentric, compressional ridges, and (2) probably abundant volcanism, high heat flow, and lithospheric thinning at the center of the fracture system. Contemporaneous global thermal expansion [*Zuber and Parmentier*, 1984*b*], expected if a large-scale thermal anomaly were to develop in cooler, convecting material, would have caused global tension and would have expanded the domain of proximal radial troughs. Conversely, global compression would have expanded the domain of distal concentric ridges.

Model 4: Dynamic uplift (Figure 6d). This type of uplift would be produced by the vertical velocity of an upwelling convection current. As in the case of isostatic thermal uplift, a central region of abundant volcanism and lithospheric thinning would have resulted from high heat flow over the rising current. However, as was shown by *Sleep and Phillips* [1985], a different stress field than that produced by isostatic uplift would have resulted in a different fracture pattern. Proximal extensional features would be arranged concentrically, and distal compressional features would be arranged radially. As in the previous case, contemporaneous global volume change would have expanded or contracted the domain of extensional deformation. A variant of this mechanism, a rising plume in a liquid water mantle, was proposed by *Casacchia and Strom* [1984] to have formed furrow systems I and II.

Model 5: Large-scale negative diapirism (Figure 6e). This model envisions large-scale, diapiric sinking of dense, silicate-enriched material or a Rayleigh-Taylor unstable ice phase [*Parmentier and Head*, 1979]. Silicate-rich material overlying more ice-rich material could have resulted from accretional melting and ice-silicate differentiation in the outer portion of the satellite [*Schubert et al.*, 1981; *Kirk and Stevenson*, 1987]. The satellite's core, consisting of a cold, undifferentiated ice-silicate mixture, would have warmed gradually due to radiogenic heating. When core viscosity

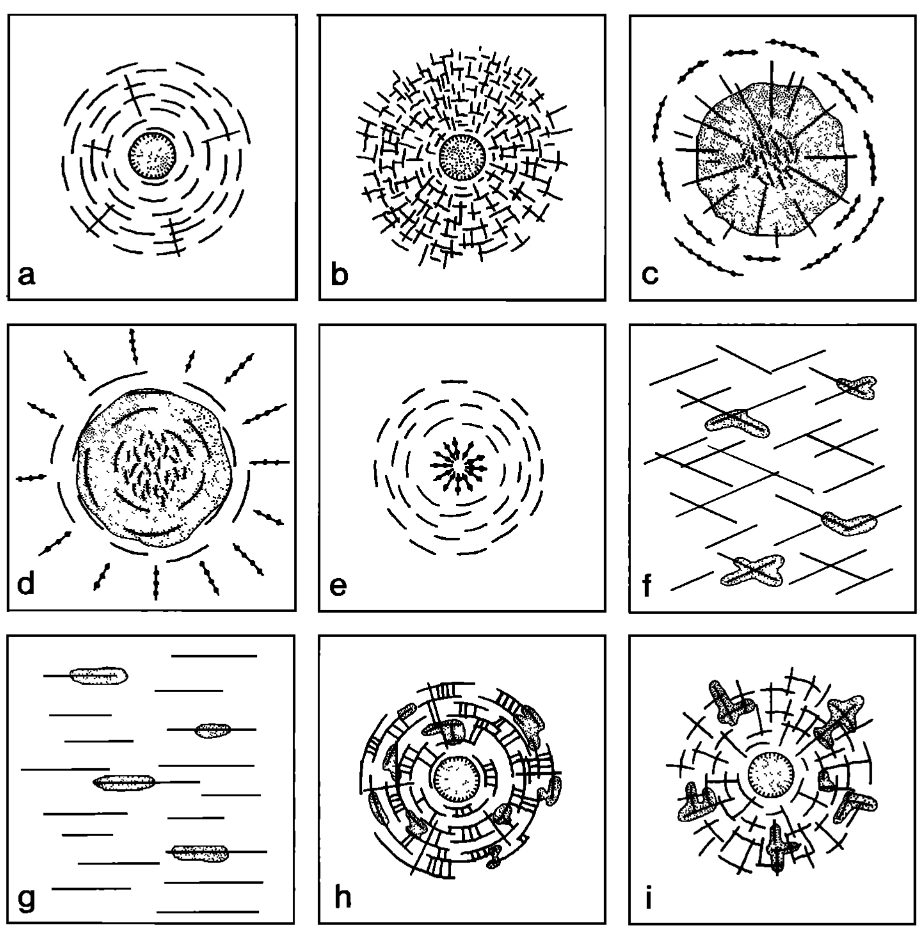

Fig. 6. Schematic maps of structures and material deposits predicted by each of the nine models of furrow origin that are discussed in the text. Solid lines are normal faults or troughs and dotted solid lines are compressional features. Stippled areas represent volcanic deposits; where enclosed by hachured lines, they represent degraded impact features.