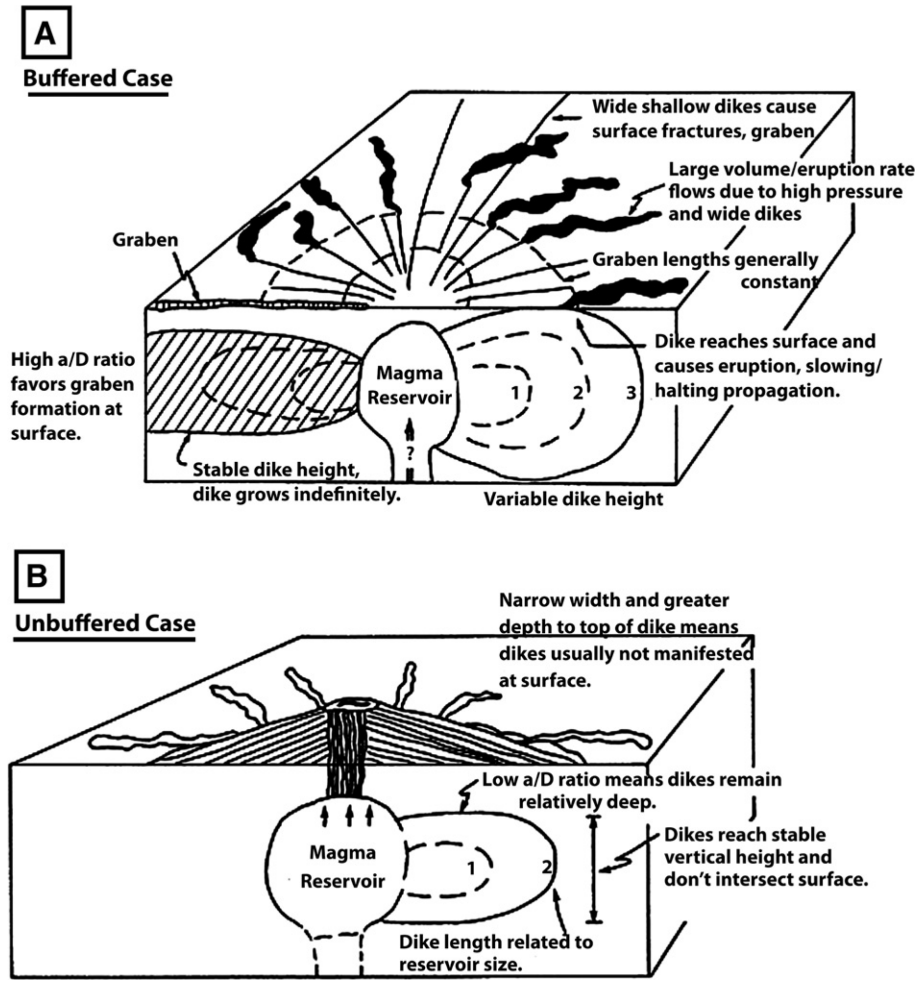

Fig. 6. Block diagrams and cross sections illustrating dike swarms and surface structure radiating away from the central region above an intrusion. (A) Schematic illustration of the behavior of dikes emplaced under buffered conditions. Depth to dike center is *D*; *a* is dike half width. (B) Schematic illustration of the behavior of dikes emplaced under unbuffered conditions. From Parfitt and Head (1993).

segments fade into the background plains at their ends (Fig. 8E, G), suggest that some of the graben may be flooded and embayed; the albedo and spectral homogeneity of the plains, however, makes definitive assessment difficult.

(9) *Superposed impact craters*: Abundant impact craters, the most prominent being Apollodorus (Figs. 7 and 8B), and secondary crater clusters and chains (Fig. 8H) are superposed on the graben system. With the possible exception of one crater (Fig. 8B, bottom center) we found no evidence of a crater greater than 5 km cut by a graben. This pattern implies that the graben swarm formed soon after the emplacement of the Caloris floor plains (Strom et al., 2008). This inference is confirmed by crater counts in a 10^5 km^2 area centered on Pantheon Fossae, which show no substantial differences from crater counts for the entire floor of Caloris presented in Strom et al. (2008).

These observations of the nature of the Pantheon Fossae complex form the basis for understanding its origin, location, and timing, and its relationship to Caloris basin fill and Apollodorus crater. Graben structures radiating away from a central rise at all scales are common occurrences on terrestrial planets and have been related at the small scale to laccolithic sill intrusions, domical uplift, and fracturing, and at the large scales to broad thermal and mechanical uplift often associated with sites of mantle upwelling (e.g., Tharsis on Mars, Banerdt et al., 1992; Beta Regio on Venus, Basilevsky and Head, 2007). At intermediate scales, such as that of Pantheon Fossae, graben commonly radiate away from volcanic edifices and subsurface magma reservoirs and are formed as the surface manifestation of radial dike emplacement (e.g., Johnson, 1961; Parfitt and Head, 1993; Ernst et al., 1995). Overpressurized shallow magma reservoirs propagate magma-filled cracks (dikes) radially away from the reservoir (Odé, 1957; Pollard and Muller, 1976; Delaney and Pollard, 1981; Gudmundsson, 1984; but see Grosfils, 2007). In cross section, these dikes appear as elongated blade-like forms (Fig. 6), and as they approach the surface they create a near-surface extensional stress field that commonly results in a graben, the width of which is related to the width of the dike and its orientation relative to the regional stress field (Pollard, 1987; Delaney, 1987; Mastin and Pollard, 1988; Parker et al., 1990) (Fig. 6A). For an isolated dike, the dike width is proportional to the total surface extension perpendicular to the dike, although the proportionality depends on other properties of the dike (Mastin and Pollard, 1988; Head and Wilson, 1993). Dikes associated with terrestrial mafic dike swarms are typically 30–50 m wide and can range up to 100–200 m in width (Ernst et al., 1995). Single dikes hundreds of meters in width are inferred for many planetary examples (Head and Wilson, 1993; Wilson and Head, 2002); multiple dike emplacement events can enlarge a graben. The resulting graben can be either laterally continuous, discontinuous, or *en echelon*, depending on the depth of the reservoir, the magnitude of the overpressurization event, modulations in the overpressurization event(s), surface topography and geology, and variations in the near-surface stress field. These same factors help determine whether a dike reaches the surface and results in eruption of lava (Pollard et al., 1983; Rubin and Pollard, 1987; Rubin, 1992). The full