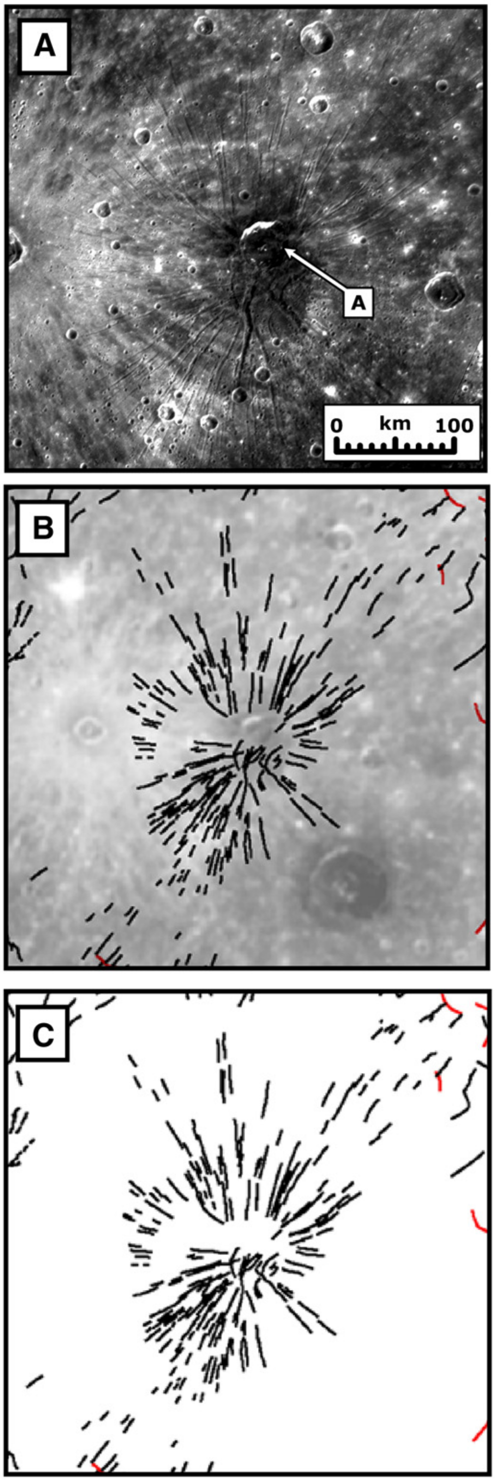

Fig. 7. Radial graben structure of Pantheon Fossae. (A) Graben (fossae) radiating from the center of the structure. Apollodorus crater (identified by the letter "A") is offset slightly to the north–northeast from that center. Mosaic of MDIS NAC images EN0108826752M, EN0108826757M, EN0108826762M, EN0108826817M, EN0108826822M, and EN01088268247M. (B) Distribution of tectonic structures in the Caloris basin with MDIS mosaic as background. Black, graben; red, wrinkle ridges (structural features interpreted to be caused by horizontal shortening). Mosaic of MDIS NAC images EN0108826752M, EN0108826757M, EN0108826762M, EN0108826817M, EN0108826822M, and EN01088268247M. (C) Structures only. (B) and (C) are from Watters et al. (2009a-in this issue); Lambert conformal projection.

range of cases (eruption dominated, mixed eruption and graben formation, only graben formation) has been observed on the terrestrial planets.

Whether the dikes propagate radially away from the reservoir, or are concentrated in discrete zones, is known to be linked to the nature of the local and regional stress field. For example, dikes propagating away from the Kilauea magma reservoir on Hawaii are concentrated in discrete rift zones, the orientation of which is controlled by the regional stresses associated with the collapse of the margins of the edifice and the formation of listric faults (Fornari, 1987; Ryan, 1988). This relationship has been used to reconstruct regional stress fields in the geological record on Earth (e.g., Johnson, 1961; Halls, 1982; Sigurdsson, 1987), Venus (Grosfils and Head, 1994a,b; Crumpler and Aubele, 2000), and Mars (Banerdt et al., 1992). Examples of radially symmetrical dikes and graben are also known (e.g., Krassilnikov and Head, 2003; Ernst et al., 2003); these occurrences imply a regionally homogeneous stress field. In these cases, individual magma-reservoir overpressurization events are not sensing a regionally heterogeneous stress field but are more likely controlled by local heterogeneities in the walls of the reservoir and thus are more random (Parfitt, 1991). Radial dike swarms propagating from magma reservoirs have also been used extensively to reconstruct widely dispersed Archaean continental fragments on Earth (Bleeker, 2002, 2003, 2004; Bleeker and Ernst, 2006).

Radial dike swarms often show two populations in terms of length, which can be understood in the context of buffered and unbuffered conditions in the magma reservoir (Parfitt and Head, 1993; Fig. 6). One population, the most abundant, is concentrated in the vicinity of the reservoir. Typical magmatic additions to the reservoir from depth, or changes within the reservoir, cause reservoir inflation, resulting in elastic expansion of the region around the reservoir. Inflation continues until the elastic expansion can no longer accommodate the increased magma supply (estimated to be less than a few percent of the reservoir volume; Blake, 1981), and at that point, brittle failure of the reservoir wall occurs and a magma-filled crack is propagated radially away from the reservoir. This situation is known as unbuffered dike emplacement from a magma reservoir (Fig. 6B) (Parfitt and Head, 1993); the magma input, inflation, and output (dike emplacement) are all relatively in equilibrium, and this pattern results in the emplacement of dikes of generally comparable length, creating the near-field dike swarm.

Occasionally, however, magma supply from depth far exceeds the norm, and the magma reservoir is no longer in equilibrium. In this situation, known as the buffered dike emplacement case (Fig. 6A) (Parfitt and Head, 1993), magma enters the reservoir and causes inflation, but once brittle failure of the reservoir wall is initiated the dike continues to propagate until the anomalous magma supply is depleted or the reservoir stresses are equilibrated. In theory, buffered magma-reservoir supply events can result in dikes radiating many multiples of the distance reached by the unbuffered dikes, up to hundreds to even thousands of kilometers away from the reservoir (Parfitt and Head, 1993), and indeed examples of these types of events are known on Hawaii (e.g., Holcomb, 1987) and the Canadian shield (Ernst and Baragar, 1992) and inferred on Mars (Wilson and Head, 2002) and Venus (Parfitt and Head, 1993; Grosfils and Head, 1994a,b; Krassilnikov and Head, 2003; Ernst et al., 2003).

These processes and the relationships observed on the terrestrial planets can be used to assess whether the Pantheon Fossae feature is a candidate for radial dike emplacement events, and if so, what its presence, characteristics, and relationships might tell us about the evolution of the Caloris basin interior. First, the size of the individual Pantheon Fossae graben and their geometry are very similar to dozens of examples of novae on Venus, interpreted to represent the surface manifestations of radial dike swarms (Krassilnikov and Head, 2003) (Fig. 9A). The radial symmetry is also similar to many of the novae seen on Venus (Krassilnikov and Head, 2003) (Fig. 9), although