segments have better-defined margins (parallel to the groove) than septa (normal to the groove) and the septa are usually subdued.

e) *Change in groove morphology with distance*: The monotonic decrease in velocity of rolling boulders, and any change in the size and morphology of the boulder as it moves, will result in variations in groove morphology with distance. In addition, when the influence of the non-spherical shape of Phobos on the motion of ejecta clasts is considered, we find that the speed of a clast may increase again after an initial decrease (see Figs. 10 and 11). These factors should result in changes of morphology along groove paths, as gravity, velocity, and local topography vary along its course. Indeed, such along-strike variations in morphology are observed in mapped Phobos grooves (Fig. 12). For example, when many of the mapped grooves extend around the equatorial regions of the sub-Mars meridian (Fig. 12a and b), they show distinct along-strike changes from a pitted morphology, to elongated pits, to isolated pits (see the two largest features in Fig. 12a and b, in particular). The same type of relationship is shown in the trailing hemisphere (Fig. 12a and c), where grooves formed of overlapping pits give way to isolated smaller pits along the strike of the groove, before the groove structure disappears entirely.
The same types of morphological trends are seen along numerous grooves in the trailing hemisphere (Fig. 12a and d), as the grooves reach the zone of avoidance. Here, grooves of all types and widths are observed, converging on the zone of avoidance. Several general trends are observed. First, the grooves generally decrease in width toward the zone of avoidance. Second, they change morphology along groove strike toward the zone of avoidance, from beaded overlapping pits, to more widely spaced pits along strike, and finally in many cases to discrete rows of pits, before disappearing entirely. Local and regional variations in gravity and velocity, as well as changes in boulder size and shape due to rolling-induced breakup, could clearly be factors in accounting for the observed variations. For example, some Class II grooves (Murchie et al., 1989) change from single to bifurcated or multiple grooves along their paths (Fig. 1), a morphology consistent with the breakup of a large boulder into two or more fragments, a phenomenon for which evidence is commonly seen on the Moon (Fig. 1f–g).

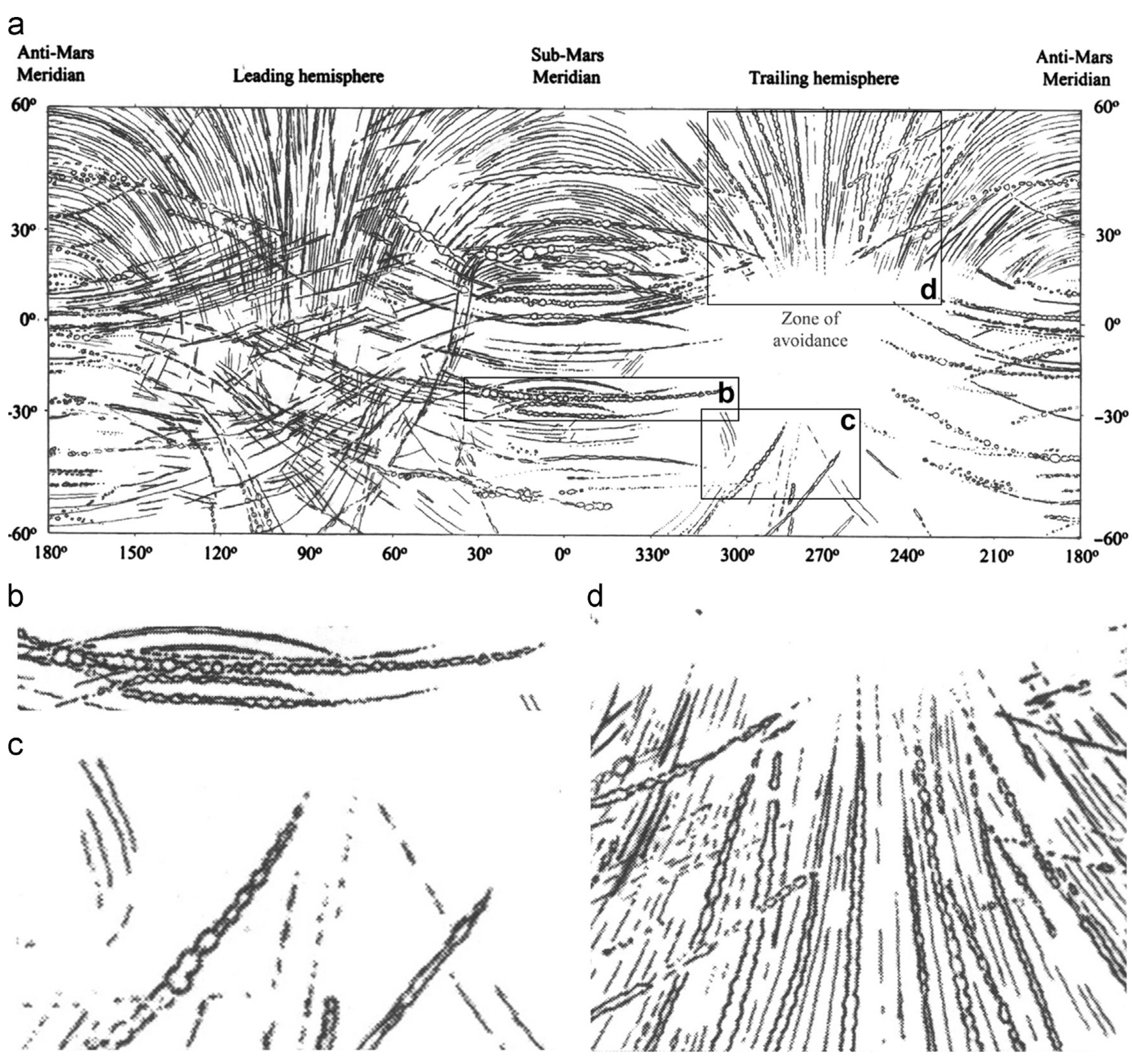

Fig. 12. Characteristics of groove along-strike variations, crossings, and terminations in the global groove map of Murray and Heggie (2014). (a) Global groove map showing locations of enlargements for Fig. 12b–d. Enlargements show along-strike variations in groove characteristics. (b) Distinct changes in along-strike morphology from a pitted morphology, to elongated pits, to isolated pits, narrowing, and then disappearance (see particularly the two largest features). See Fig. 12a for location. (c) Grooves composed by overlapping pits give way to isolated smaller pits, and then to isolated pits along the strike of the groove, before the groove structure disappears entirely. See Fig. 12a for location. (d) Trends in groove morphology as the grooves reach the zone of avoidance (a). Grooves of all types and widths are observed, converging on the zone of avoidance. Grooves generally decrease in width toward the zone of avoidance; they change morphology along groove strike toward the zone of avoidance, from beaded overlapping pits, to more widely spaced pits along-strike, and finally in many cases to a row of pits, before disappearing entirely. See (a) for location and (d) has been rotated 180°.