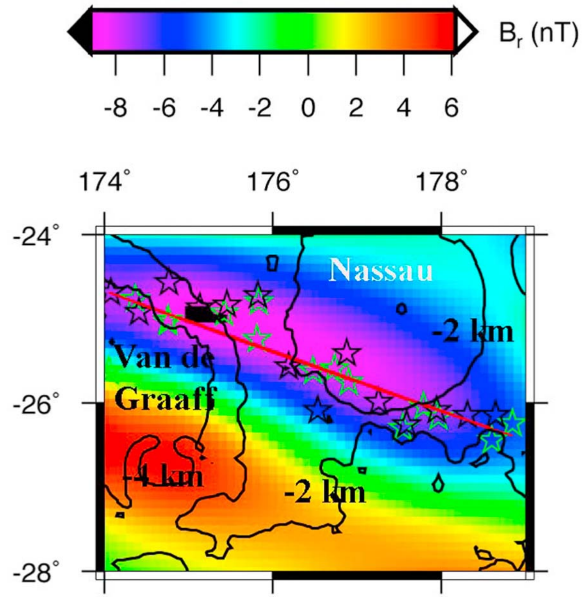

Figure 6. Location of most negative radial field values along low altitude (black stars) and high altitude (green stars) passes shown in Figure 5. Topographic contours in km relative to the lunar datum are shown in solid lines, and the two major basins, Van de Graaff and Nassau are located. The red line is the linear least squares fit to the locations. The radial magnetic field map (Figure 1) is also shown in color as a background. The area shown here is outlined in Figure 1.

different magnetization direction would change the magnetic field pattern and so should be recognizable in the analysis.

4. Discussion

[13] The proximity of these magnetic lineations to the South Pole-Aitken basin suggests that the lineations may be related to the formation of the basin or its subsequent history. Preservation of magnetic fabric dating from early crustal formation processes seems unlikely, due to the physical disruption of crustal target material by the impact and the likelihood that the event would tend to demagnetize and destroy magnetic lineation coherency in the immediate vicinity of the impact. Subsequent to the formation of the South Pole-Aitken basin, the major events in the history are the formation of additional craters and small basins in the basin interior and rim (e.g., Poincaré, Antoniadi, Apollo, Van de Graaff, Aitken and many others) and the formation of the Orientale basin to the east and deposition of Orientale ejecta and crater chains in the interior of SPA [e.g., *Stuart-Alexander*, 1978; *Wilhelms et al.*, 1979; *Wilhelms*, 1987]. Emplacement of mare basalts on the SPA basin floor occurred well after basin formation and thus mare basalt eruptions tended to pond within the many craters that formed between the time of the impact and the volcanic flooding, and in other low-lying intercrater areas. Unlike the larger nearside maria, such as Imbrium and Serenitatis, which are characterized by widespread, continuous and thick mare deposits [e.g., *Head and Wilson*, 1992; *Wilhelms*, 1987], SPA is incompletely flooded and has a patchy mare distribution. *Yingst and Head* [1997] mapped 52 mare ponds in the South Pole-Aitken basin, with a mean pond area of 2000 sq km, and a mean volume of 860 cubic km. They interpreted the ponds to be due largely to single eruptive phases that were emplaced through dikes directly from mantle sources without shallow crustal magma reservoirs and staging areas.

[14] The timing and strength of the source magnetizations responsible for these magnetic lineations is poorly constrained. *Yingst and Head* [1999] examined the spectral characteristics of 21 of the mare ponds in SPA and found that their affinities were consistent with nearside basalts emplaced in the Late Imbrian Period, a conclusion confirmed by SELENE crater counts [*Haruyama et al.*, 2009]. The possibility also exists for the presence of earlier cryptomaria on the floor of SPA [*Pieters et al.*, 1997]. The recent works of *Garrick-Bethell et al.* [2009] and *Lawrence et al.* [2008] on the lunar sample collection have yielded conflicting interpretations on the question of the existence, timing, and possible strength of a lunar dynamo. We can confidently say only that the Moon may have possessed a surface field of intensity comparable to or smaller than that of the present-day Earth at one or more times in the past, and the favored periods for the existence of a lunar dynamo are the Imbrian, the Nectarian, and the pre-Nectarian. Our knowledge of the expected magnetizations of the basaltic

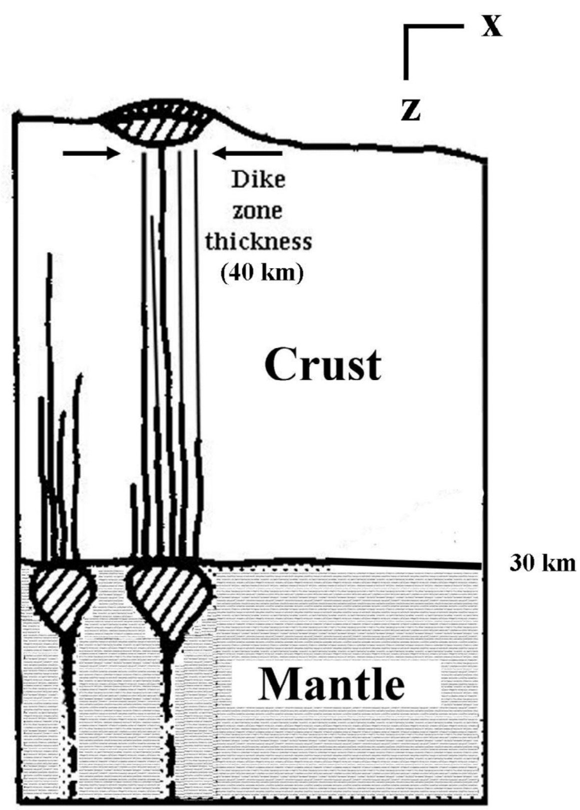

Figure 7. Schematic figure of two dike swarms in the lunar crust, and coordinate system used in the dike geometry problem. The dike is assumed infinite in the $+y$ and $-y$ directions. The dike swarm on the right extends from the base of the crust to the near-surface, where it is shown breaking the surface.