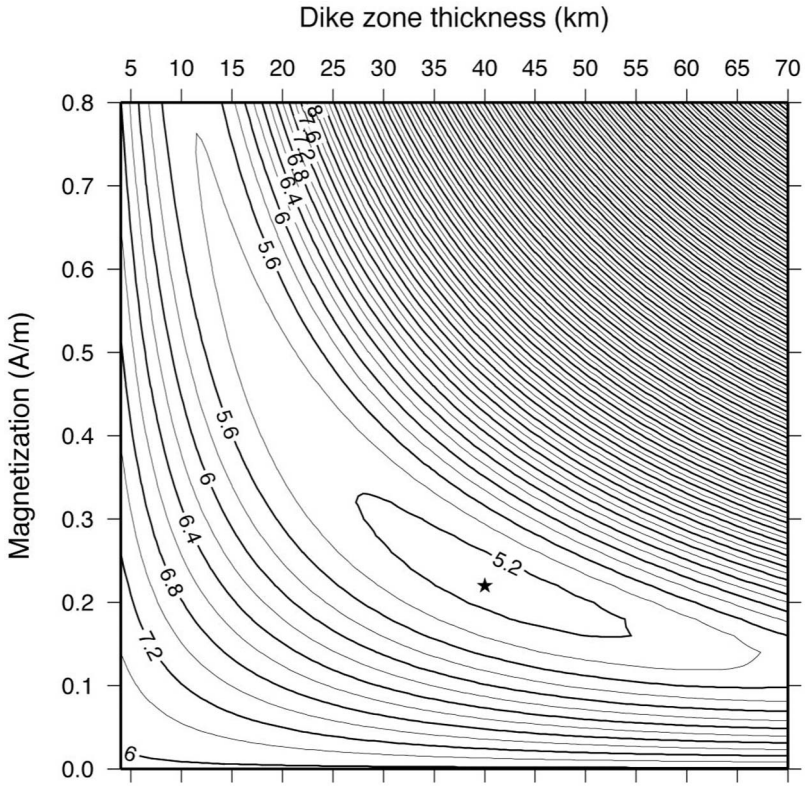

Figure 8. RMS trade-off curve of dike magnetization versus dike zone width. Filled star locates the minimum with magnetization equal to 0.22 A/m and a dike zone thickness (Figure 7) of 40 km, corresponding to 80 dikes each 0.25 km wide, separated from the adjacent dike by a similar width of non-magnetic material. These model parameters are used to calculate the predicted modeled field shown in Figure 5.

magma from which the dikes originated is also not well known [*Wieczorek and Weiss*, 2010] because it depends on the strength of the magnetizing field, the magnetic mineral responsible for the magnetization, and the amount of iron in the source rocks. *Wieczorek and Weiss* [2010] suggest values between 0.1 and 0.4 A/m for a variety of plausible scenarios, consistent with the values reported here.

[15] Examination of the location of the magnetic lineations shows some positive correlation between their concentration and mare pond locations (Figures 1 and 2). Furthermore, the magnetic lineations cross specific mare ponds in some locations. For example, the most prominent linear anomaly trends WNW and crosses mare patches in Van de Graff (3, 4), Leeuwenhoek (9), and Apollo (21–23), and trend-parallel graben and mare-related dark-halo craters on the floor of Oppenheimer [*Head et al.*, 2000]. Other linear trends also show correlations with mare patch occurrences. Not all magnetic lineations are associated with mare ponds. In this scenario, not all intrusions reached the surface and resulted in mare ponds. In contrast, all but one of the mare ponds has a magnetic signature greater than the lunar median value, and 18 of the 26 ponds have magnetic signatures above the 75th percentile (Figure 4).

[16] The modeling performed here can not resolve some ambiguities that are inherent in the interpretation of potential field data. For example, because a uniform magnetization can be added to any assumed magnetization distribution with no effect on the measured magnetic field outside [*Runcorn*, 1975; *Purucker and Nicholas*, 2010], it is impossible to distinguish between some plausible geologic scenarios unless samples of the magnetized bodies are available. The satellite is sensitive to only lateral magnetization contrasts. As an example, it is impossible to determine whether the inferred dikes were emplaced in a host rock that was already magnetized, or whether the host rock was non-magnetic.

5. Conclusion

[17] In summary, a number of lines of evidence support an interpretation of the linear magnetic anomalies as the manifestation of magnetized dikes related to the ascent of magma and emplacement of mare basalts on the floor of the South Pole-Aitken basin: (1) the linear nature of the magnetic anomalies and the linear nature of dikes, (2) the concentration of the anomalies in the center and NW portions of the basin where the mare ponds are also concentrated, (3) the coincidence of some magnetic lineation locations with specific basaltic ponds, and (4) the candidate width and depth range of the mare pond feeder dikes and the strength of the magnetic lineations. Thus, we interpret the linear magnetic anomalies to have formed by dikes that emplaced many of the mare ponds on the floor of SPA, with solidification of the dikes taking place in the Late Imbrian, probably 3.6–3.8 Ga, and possibly earlier, during the emplacement of cryptomaria [*Pieters et al.*, 1997].