Origin of Magnetic Fabrics in Granites from the Cadillac Mountain Intrusive Complex, Maine

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The Silurian Cadillac Mountain Intrusive Complex (CMIC) is part of the coastal plutonic and volcanic belt of Maine. It contains three major intrusive rock units: fine-grained granites, coarse-grained granites, and gabbro-diorite. Both types of granite show a high magnetic susceptibility. The results of alternating-field demagnetization experiments indicate that the predominant magnetic mineral in the granites is coarse-grained (i.e. multi-domain) magnetite. Moreover, the alternating-field demagnetization results do not reveal a believable Silurian paleomagnetic direction. However, the granites have a strong anisotropy of magnetic susceptibility (AMS), and the coarse-grained granites are more isotropic than the fine-grained granites. The magnetic lineations trend east-northeast and plunge shallowly (2º-17º), and the foliations also strike northeast with varying dips (8º-81º). Although AMS fabrics are strong, rock fabrics defined by the shape preferred orientation (SPO) of major minerals, such as quartz and feldspars, are absent or weak, which is a seeming contradiction. Since the AMS signal appears not to relate to the SPO of major minerals, it may instead arise from one of two sources: (1) the SPO or distribution anisotropy of the magnetic minerals, or (2) a preferred orientation of magnetic domains within magnetite grains. Because there is no significant change in the orientation or grouping of the AMS of samples after demagnetization of the granites, the AMS probably does not arise from the second source. Therefore, it is likely that the origin of the AMS fabrics relates to the shape and/or distribution of the magnetite grains.

What is the significance of these AMS fabrics? Did they develop before or after the pluton crystallized and cooled? Petrographic examination of the samples reveals no evidence for solid-state deformation of the granites, suggesting a magmatic origin for the AMS fabrics. However, the geometric relation between the AMS fabrics and magmatic features of the pluton remains unclear. Previous work suggests that the pluton floor is shallow and sub-horizontal, and yet the AMS foliations have widely varying dips; this incongruity remains to be resolved.