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Relationship between shear zones and plutons in the Archean: example from the Pukaskwa batholith, Superior Province, Ontario

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The relationship between granite emplacement and deformation along shear zones or faults has generated a heated debate (e.g., Neves et al., 1996; Paterson and Schmidt, 1999). The main controversy is that, for some, granite plutons occur in close spatial association with shear zones or faults, which leads to the possibility that magmas might be collected at depth and drained upwards along shear zones (*hypothesis 1*). For others, the presence of partially molten zones in the lithosphere would weaken the crust and alow for strain localization along shear zones (*hypothesis 2*). Finally, some contend that no spatial relationship exists between plutons and faults (*hypothesis 3*). While hypotheses 1 and 2 are not mutually exclusive since feedback relationships could exist, we suggest that differences in shear zone kinematics (e.g., transtension vs transpression) or thermal regimes (e.g., Archean vs Phanerozoic) may play an important role in magma migration.

The Archean Superior Province in Ontario is an excellent natural laboratory to test various tectono-magmatic scenarios. The Pukaskwa batholith is a large coalescence of several granitic plutons, probably of different ages (ca 2.7 Ga), that occur broadly to the south of the east-west striking Hemlo shear zone. The main batholith rocks include tonalite gneisses, foliated hornblende-bearing granodiorite, massive unfoliated granodiorite, amphibolites and numerous dykes. The shear zone consists of supracrustal assemblages with greenstone belt affinity.

Recent petrostructural field observations and measurement of the anisotropy of mag-

netic susceptibility (AMS) along the Oiseau Bay NS cross-section (20 km, 20 stations, 520 specimens) provide new insight in the development of the northern margin of the Pukaskwa batholith. In the studied section, the granites display a magnetic susceptibility (K, low field) ranging from 35 to 8543 x 10^{-6} [SI] (average $\approx$ 927 x 10^{-6} [SI]). The average degree of magnetic anistropy (Pj = 1.184) is high which is consistent with a magnetostatic origin for the AMS due to a ferrimagnetic phase such as magnetite. The shape parameter, often used as a strain marker, is mostly oblate (T = 0.225) but here it is not deemed significant because the concentration of magnetite is highly variable. Instead, the symmetry of the fabric is evaluated based on the group fabric of the specimens of the same station. The AMS data shows two main petromagnetic types: (I) low K in which the AMS is carried by single domain magnetite inclusions in the lattice of ferromagneian minerals and (II) high K in which the AMS is carried by multidomain

Stations in the south of the Oiseau Bay section have slightly more oblate fabrics than those to the north. Magnetic lineations in the North are steeper than in the South. This is interpreted as resulting from either doming and exhumation of the Pukaskwa batholith along its northern margin or alternatively from constrictive deformation along the northern margin in a strike slip transpressional regime. Evidence for strike slip kinematics along the Hemlo shear zone is common to the east of the studied area. The magnetic fabric of amphibolite inclusions (a few tens of cm in diameter) are distinct from that of the host granite. This and ubiquitous polygonal microstructures suggests that the granites and their inclusions did not experience substantial solid state deformation.