METAMORPHISM AND PLUTONISM IN THE QUETICO BELT, SUPERIOR PROVINCE, N.W. ONTARIO

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Reconnaissance study of 350 km of strike length of the 1200-km-long Quetico belt reveals regional patterns of metamorphism and plutonism. Located between the Wabigoon and Wawa greenstone-granite belts, the Quetico belt consists of a marginal metasedimentary schist unit and an interior complex of metasedimentary schist and gneiss and plutonic rocks. Metamorphic grade in marginal pelitic schists varies from a chlorite-muscovite zone at the outer margin to a garnet-sillimanite zone toward the interior. Common assemblages of garnet-andalusite throughout the marginal unit and in the interior in the Lac La Croix area indicate low-pressure metamorphism (bathozone 2). Assemblages of staurolite-sillimanite and rare kyanite some 60-150 km east of Lac La Croix suggest bathozone 3 conditions. Mineral assemblages in peraluminous granitoid leucosome dykes and plutons also vary regionally along strike. Sillimanite, in association with garnet and muscovite, is common in the west; cordierite is present only to the east. Leucosome in migmatites is mainly intrusive in the west and locally derived in the east. These features together suggest a deepening level of erosion from west to east.

Two large plutonic complexes characterize the interior of the western Quetico belt: the Vermilion complex of Minnesota and the Quetico Park complex (1) of Ontario. The Vermilion complex consists mainly of biotite granite and leucogranite with metasedimentary schist inclusions. A zonation in plutonic rock types characterizes the Quetico Park complex across its 20-50 km width. Peraluminous white granite of the Sturgeon Lake batholith (2) occurs in the centre of the complex and is flanked by older, small (<10-km-wide) plutons of pink biotite ± magnetite leucogranite, rarely with inclusions of monzonite-diorite-hornblendite. Small (> 5 km) plugs of diorite-monzonite cut marginal metasedimentary schists.

The two granite types of the Quetico Park complex have distinctive mineralogical, textural and chemical characteristics. Biotite leucogranites are generally homogeneous, massive medium-grained rocks with less than 5% biotite and some magnetite. Granites of the Sturgeon Lake batholith are coarse-grained to pegmatitic, have numerous metasedimentary inclusions and contain some combinations of garnet, muscovite, sillimanite, cordierite, biotite, apatite, tourmaline and rare fluorite in addition to quartz and alkali feldspar. Ferromagnesian minerals have high Fe/Fe+Mg ratios and garnet is spessartine-rich. Chemically, the Sturgeon Lake rocks are higher in SiO_2 than biotite leucogranites, and lower in TiO_2, Fe_2O_3, FeO, Fe_2O_3/FeO, CaO, Na_2O, Na_2O/K_2O, Rb, Sr and REE. Biotite leucogranite has a fractionated REE pattern with a negative Eu anomaly (3).

Zircons in both granite types are complex, with cores and overgrowths and resorbed appearance. Texturally-simple monazite is being used in U-Pb geochronology.

U-Pb zircon geochronology places constraints on the timing of development of the Quetico belt. In the Wabigoon metavolcanic belt to the north, volcanism and early plutonism occurred at 2750-2702 Ma and late plutonism at 2695-2680 Ma (4).

The Wawa-Shebandowan metavolcanic belt was active at the same time, with volcanism in the interval 2749-2696 Ma (5) and late plutonism at 2690-2675 (6). Sediments were deposited in the Quetico basin before intrusion of the Poohbah Lake complex at ~2700 Ma (7) and were probably derived from adjacent volcanic highlands.

A composite section through the belt shows steeply inward-dipping margins and tadpole-shaped plutons derived from a metasedimentary source in the centre and tonalitic rocks of the greenstone-granite terranes towards the margins. A back-arc or inter-arc basin environment is postulated to account for early development of an elongate sedimentary trough characterized by high heat flow which led to later deep crustal melting and magma rise to high structural level. Underplating by mafic magmas possibly contributed to heat transfer from the mantle to the lower crust.

References

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