

Mineralogy and geochemistry of dacitic rocks accompanying the Murgul (Artvin, NE Turkey) massive sulfide deposit

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Murgul (Artvin, NE Turkey) volcanogenic massive sulfide deposit, being in the eastern part of the Black Sea island arc in the NE Turkey is associated with the Upper Cretaceous felsic volcanics located along the margin of a caldera with a diameter of approximately 35 km. In the mine area, there are at least two types of dacites formerly known as the pyrite-bearing dacite (footwall dacite) and purple and green colored porphyritic dacite without mineralization (hanging-wall dacite). The footwall dacite consists of dacites and dacitic pyroclastic rocks. Pyrite is ubiquitous in the footwall dacite, the most heavily altered dacite. The texture of footwall dacite are mostly porphyric and less spherulitic. Also, quartz shows embayed and skeletal textures. The main minerals in footwall dacite consist of quartz, plagioclase, biotite and sanidine; pyrite also present as opaque mineral. Hanging-wall dacite is characterized by the columnar joints, consists of slightly altered dacite and tuffs and is porphyric texture. Quartz shows embayed texture whereas plagioclase sieve texture. The hanging-wall dacite are composed of plagioclase, quartz and amphibole.

Lithochemical data indicate that the footwall dacitic rocks and hanging-wall dacitic rocks are between tholeiitic and transitional in character, and display characteristics of volcanic arc. The Zr/Y and La/Yb values for the footwall dacite are 2.02 to 4.84 and 1.49 to 4.96 and for hanging-wall dacite 2.99 to 3.89 and 2.17 to 3.26, respectively. The trace element patterns of the rocks show considerable LILE enrichment (K, Rb and Ba) and island arc properties with depletion in Sr, P and Ti relative to N-type MORB. Chondrite-normalized REE patterns of the hanging-wall dacite show pronounced REE enrichment respect to the footwall dacite. The geochemical variations in the dacitic rocks can be explained fractionation of common mineral phases such as plagioclase, hornblende and apatite.

Controls on calc-alkaline differentiation and composition of the continents

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Compositional similarities between bulk continental crust and calc-alkaline (CA) magmas continue to motivate laboratory and field investigations. Some first order observations are that CA magmas tend to have higher H₂O concentrations than arc tholeiites (TH), (hydrous phenocrysts, explosive eruptions, melt inclusions); that CA magmas are common along emergent continental margins whereas TH dominate intra-oceanic arcs; and that evolved CA magmas are typically more oxidized than TH (CA ≥ NNO ≥ TH). Experimental studies show that high H₂O concentrations promote CA differentiation by lowering the appearance temperatures of silicates, but less so FeTi oxides, so that oxides make up greater proportions of near-liquidus crystallizing assemblages. However, not all CA suites are especially H₂O-rich. Experiments on moderate-H₂O (~4 wt%) andesites and dacites from Mt. Rainier, Washington, reproduce the volcano's CA compositional array at log fO₂ ~NNO+2 (this talk) due to abundant FeTi oxide crystallization. Likewise, near-solidus melts of moderate-H₂O (~2 wt%) basalts/gabbros are CA at fO₂ >NNO but are TH at QFM [1]. A generalization is that fO₂ ~NNO leads to FeO*/MgO vs. SiO₂ differentiation trends parallel to Miyashiro's TH/CA boundary. Flatter, strongly CA trajectories require higher fO₂ or other processes (assimilation/mixing). What remains poorly known is if mafic parents to CA suites are appropriately oxidized (>NNO). If yes, crystallization-differentiation can account for CA suites (+/-mixing/remelting of earlier magmas), and could explain the continental crust's composition. But why would oxidized parents be more prevalent along the continents than in the oceans? A shorter mantle melting column [2] or enhanced intra-mantle/deep-crustal crystallization of Fe³⁺-poor mafic assemblages [3] might explain higher oxidation states of CA parents. However, if mafic parents to common CA suites turn out not to be suitably oxidized, then oxidation by assimilation of crustal materials that have passed through the weathering cycle may be critical. A possibility, then, would be that the CA composition of the continents is an artifact of their emergence above sea level. As they emerge, they erode, producing oxidized sediments that with burial and tectonism become available for assimilation and oxidize subsequent magmas promoting their CA differentiation.

[1] Sisson *et al.* (2005) *CMP* **148**. [2] Plank & Langmuir (1988) *EPSL* **90**. [3] Muntener *et al.* (2001) *CMP* **141**.