Comparison of Late Cretaceous Plutonic Rocks Across the Left-Lateral San Antonio Canyon Fault, San Gabriel Mountains

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Introduction

The San Antonio Canyon fault (SACF; Figure 1) of San Antonio Canyon, southeastern San Gabriel Mountains, is an active fault (Hauksson and Jones, 1991) within an expansive system of left-lateral strike-slip faults that were initiated during Middle Miocene time when the incipient San Andreas fault was developing (Nourse, 2002). We report here results of geological mapping and X-ray fluorescence spectrographic analysis that support a hypothesis of 10 km aggregate left-lateral displacement across the San Antonio Canyon fault.

Geologic and Tectonic Setting

The southeastern San Gabriel Mountains (Figure 1) have undergone multiple stages of faulting, uplift, and translation. The area may have originally been a Neoproterozoic-Paleozoic miogeoclinal setting because it displays similarities to miogeoclinal sequences in other areas of southern California. Dextral zircons from Potato Mountain quartzite in (Figure 2) yield a maximum age of ~1100 Ma (Premo et al., 2007). Potato Mountain quartzite is part of a metasedimentary sequence that overlies Paleoproterozoic gneissic granite basement (1769 ± 11 Ma; Premo et al., 2007). Late Cretaceous tonalite (~85 Ma) and leucocratic granite (78 ± 8 Ma) intrude similar miogeoclinal metasediments east of the SACF on Ontario Ridge (May and Walker, 1989; Figure 1). North of the San Gabriel fault (an E-W trending Miocene dextral strike-slip fault displaced by the SACF), tonalite-quartz diorite range from 76 to 73 Ma and leucogranite is 70±1 Ma (Nourse and Premo, unpublished data).

Two phases of movement are postulated to have occurred along the SACF. Nourse et al. (1994) and Nourse (2002) outline individual time periods with respective bursts of movement involving SACF. The youngest phase of movement is 3.5 km of sinistral deflection and offset of the Late Miocene-Early Pliocene San Gabriel fault to Icehouse Canyon (Figure 1). The second, older phase of movement on the SACF is inferred by the mismatch of basement when the San Gabriel fault is realigned. This earlier phase of 6.5 km of sinistral displacement is restored by and aligning a north-dipping metasedimentary gneiss (i.e., Potato Mountain
Figure 1. An oblique Google Earth image of San Antonio Canyon. Sugarloaf Peak and the Marble Quarry are highlighted at the northern and southern ends of SAC.

quartzite) / tonalite contact. Postulated piercing point outcrops are exposed near the Marble Quarry west of Shinn Road (Figure 2) and on Sugarloaf Peak (Figure 3). Movement occurred during early Miocene, as it postdates the intrusion of Early Miocene dikes (Nourse, 2002).
Figure 2. Compiled geologic map of the marble quarry and vicinity (Heaton, 2008; modified from Nourse, 2002; and Morton and Miller, 2003)
Geological Mapping and X-ray Fluorescence Analysis of Late Cretaceous Plutonic Units

Field work and geologic mapping (Nourse, 2002; Heaton, 2008) suggest that the Marble Quarry-Potato Mountain and Ontario Ridge units are a single complex because they display similar crosscutting geologic contacts and share similar sub-units. Ontario Ridge includes a sequence of Cretaceous plutonic units intruded into north-dipping metasedimentary rocks (May & Walker, 1989) and it also contains a distinctive hornblende quartz monzonite north of Sugarloaf Peak that is juxtaposed with a marble unit (Figure 3). A similar sequence occurs north of Potato Mountain with a folded section of metasediments and Cretaceous plutonic units which also includes hornblende quartz monzonite (Ehlig, 1958, Nourse, 2002, Figure 2).

Figure 3. Detailed geologic map of Sugarloaf Peak area. Bedrock units are: quartzite (orange), leucocratic biotite granite (pink), hornblende quartz monzonite (purple), granodiorite (green), and biotite gneiss (blue). (Morton and Miller, 2003; Nourse et al., 2002)

To test correlation of the hornblende quartz monzonite (unit Khqm on Figures 2 and 3) Heaton (2008) mapped and sampled several outcrops of this rock at the Marble Quarry and on Sugarloaf Peak. Also sampled were two other major plutonic units: leucocratic biotite granite (Klbgr), and granodiorite-diorite (Kgd-tn). Multi-element X-ray fluorescence analyses of 33 samples were conducted at the Geological Sciences Department laboratory facility at California State Polytechnic University, Pomona.

Major element chemistry of the hornblende quartz monzonite unit (Khqm) shows a weak correlation, with the four Marble Quarry samples containing higher alkalis at a given SiO₂ when compared with eleven Sugarloaf Peak samples. The samples from both study areas are
Figure 4. Modified LeBas (1986) diagram showing comparison of Late Cretaceous samples from the Marble Quarry and Sugarloaf Peak study areas. Volcanic names have been replaced with their plutonic equivalents.

Figure 5. Spider diagram comparing trace element analyses of Sugarloaf Peak and Marble Quarry hornblende quartz monzonite samples.
heterogeneous, and there is little overlap between the rock units from the Marble Quarry and Sugarloaf Peak (Figure 4). Trace element data (Figure 5) also suggest sample heterogeneity, but reveal that the 15 samples have generally similar enrichment and depletion patterns which could indicate that they shared a similar genesis. The X-ray analyses indicate much better correlations between the leucocratic biotite granite unit (Klbgr) and the granodiorite-diorite (Kgd-tn) units from the respective study areas (Figures 4 and 5).

Conclusions

Comparison of geologic units and their structural configuration support a correlation between the Marble Quarry and Sugarloaf Peak sections. Total left-lateral separation of these two areas is about 10 km. The geochemical results suggest that the leucogranites and granodiorites correlate between the two study areas. Our data set does not directly support a unique correlation of the hornblende quartz monzonite unit. However, the geochemical data do not preclude the hypothesis that the hornblende quartz monzonite units on both side of SACF may have crystallized at different times from distinctive regions of the same magma body.

Cited References


