PHYSICAL, PETROLOGICAL, AND CHEMICAL TRENDS ASSOCIATED WITH THE CONVERSION OF K-FELDSPAR-ABSENT QUARTZ DIORITIC AND TONALITIC CONESTONES TO SAPROLITE IN A MEDITTERANEAN (HOT SUMMER) CLIMATE, SANTA MARGARITA ECOLOGICAL RESERVE (SMER), SOUTHERN CALIFORNIA, U.S.A.

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ABSTRACT: W. Nesbitt and colleagues proposed that weathered plutonic material will spread linearly from parental fields subparallel to the A-CN join toward the A-K join on A-CN-K diagrams, and followed by a linear trend subparallel to the A-K join towards the A apex. Such linear trends are common because soil solutions are typically supersaturated with respect to K, but not CN. At SMER, our studies reveal a weathering trend that deviates from that proposed by W. Nesbitt and colleagues. SMER lies within a Mediterranean (hot summer) climate with an average precipitation of ~39.4 cm/yr and average temperature of ~16.6˚C. We sampled corestone and adjacent saprolite in an ~123 Ma tonalite, and at two sites lying within an ~107.5 Ma quartz diorite for thin section, physical properties, and chemical analyses. We used the chemical index of alteration (CIA) to determine the degree of weathering and used the transport function (τ) for assessing changes in elemental mass. Each variety of sampled corestone lacks modal K-feldspar but contains 4.50% to 12.0% biotite. Our thin section study of samples of saprolite suggests the following order, from most to least weathered; biotite, amphibole, plagioclase, and quartz. On A-CN-K diagrams saprolitic samples spread linearly from the parental material away from the K apex toward the A-CN join. XRD and microscope analyses indicate that this trend is due to the conversion of biotite to the mixed-layer expandable clays vermiculite-illite and vermiculite-smectite. The transport function, τ, indicates that during this conversion K, Rb, and to a lesser extent Ba mass was consistently removed at the level of our sampling traverses by migrating paralithic fluids. In contrast, zero to only minor increases or decreases in the masses of most other elements reflect the spatially inconsistent and varied activity of eluviation and illuviation processes within the paralithic zone. Our data consistently suggest that in plutonic rocks lacking K-feldspar, biotite weathers more readily than plagioclase, and, as a result, it controls the direction of weathering trends in A-CN-K space. As noted above, the signature of this process is a trend in saprolitic samples extending from unweathered parental plutonic material away from the K apex and toward the A-CN join. Once biotite has been completely altered, then the weathering of plagioclase should produce a new trend extending subparallel to the A-CN join and toward the A apex. Under the Mediterranean (hot summer) conditions at SMER our data appear to have captured the first step in the initiation of this process.