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Geochemical Analysis of the Alverson Formation Volcanics in Painted Gorge, Coyote Mountains, Imperial County, California:

Abstract:

The Alverson Formation consists of mid-Miocene, continental volcanic and sedimentary rocks exposed in various locations along the western edge of the Salton Trough from the Fish Creek Mountains in the north to the U.S-Mexico border in the south. This study focuses on exposures in Painted Gorge in the southeastern Coyote Mountains near Ocotillo, California where Ruisard measured a well-exposed ~300 meter thick section of Alverson Formation volcanic rocks resting nonconformably on granitic and metamorphic crystalline basement and overlain unconformably by Pliocene Imperial Formation sedimentary rocks. Two distinct igneous events are represented in the Painted Gorge Alverson section: mid-Miocene olivine-phyric lava flows, followed by later dome-like plugs of andesite-dacite that make up the upper ~100 meters of the section. The dome deposits are easily distinguished from the main lava flows in the field. The result of this is a bimodal suite of igneous rocks, which is reflected clearly in the whole rock chemistry.

The purpose of this study was to determine whole rock major and trace element concentrations for the Alverson Formation volcanic rocks in Painted Gorge, and discuss the implications of this data for the tectonic setting and regional context in which the volcanics were erupted. Plate reconstructions of the southern California margin indicate that the Alverson Formation volcanics are post-subduction and may record initial rifting and extension association with opening of the northern proto-Gulf of California and eventual establishment of the modern San Andreas Plate boundary.

Samples were collected from the base to the top of the Painted Gorge section in November, 2014. X-ray fluorescence was utilized to determine the major and trace element content of the samples.

The Alverson Formation volcanic rocks in Painted Gorge are calc-alkaline based on a standard SiO₂ versus total alkali plot, similar to subduction-related volcanic rocks. The lower olivine phyric lava flows are basaltic andesite, while the domes are andesite, bordering on dacite. Trace element analysis however reveals much higher strontium concentrations for both groups of rocks compared to “typical” calc-alkaline magmas (~750-1000 ppm in the basaltic andesite and ~1500-2000 ppm in the dome deposits). Along with high strontium,, the Yttrium content of the Painted Gorge rocks are lower than expected in typical continental arc magmas. These features categorize the Painted Gorge deposits as high magnesian andesites and adakites. This suggests the volcanics potentially originated as a result of slab melting of the underlying Farallon Plate.