Implications of a 102 Ma Alabama Hills Granite for dextral offset in Owens Valley, CA, and the organization of Sierran magmatism

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Abstract

The Alabama Hills (AH) of CA expose a Jurassic volcanic complex and a Cretaceous pluton (AH Granite; AHG) east of the Sierra Nevada batholith (SNB) near Lone Pine, CA. New U-Pb CA-IDTIMS zircon geochronology for the AHG yields ages of 102.6-102.2 Ma. These dates are older than the previously suggested age of 85 Ma, which implied a link between the AH and the adjacent 90-83 Ma Whitney Intrusive Suite (WIS). This connection is now longer tenable. Instead, the dates suggest a link to rocks tens of kilometers NW. Whole rock samples of the AHG yield εNd(85 Ma) = 0.7068-0.7089 and εSr = 2.75 to 3.03 and extend the range of isotopic ratios for ~102 Ma plutons in the SNB.

Because there is no temporal connection between the AHG and the WIS, there is no requirement that the block be dextrally offset. Correlation of the highest density portion of the Independence Dike Swarm (IDS) between the AH and the SNB is consistent with 25-55 km of dextral offset between the Sierran range front and the AH. This is aligned with comparable rocks of the Oak Creek and Goddard pendants. Additional work is necessary to distinguish between the options of <10 km and >28 km offset, but because the offset estimate on the basis of density of the IDS is consistent with offset estimates of the AH-Goodland shear zone (queried) and the organization of Sierran magmatism in the SNB, the block is more likely than ∼28 km offset.

The Alabama Hills

• Previous zircon U-Pb dating indicates a metavolcanic complex is ∼170-167 Ma 1
• Chen and Moore2 dated the Alabama Hills Granite at ∼85 Ma
• (U-Th)/He data suggest the Hills block dropped ~2.6 km from elevation of Whitney suite3
• Multiple spatial and temporal links to adjacent 90-83 Ma Whitney Intrusive Suite4
• ∼148 Ma Independence dike swarm highly dilates Jurassic rocks in Alabama Hills block; suggests it may be dextrally offset by up to 75 km relative to Coso Range5

Geochronology

New U-Pb zircon data from four spatially distributed samples indicate Alabama Hills Granite plowed was emplaced ~103-102 Ma

• Independence dike (~151 Ma) and Jurassic volcanic sample (~170.8 Ma), agree with previous geochronology6,7
• Data indicate Alabama Hills Granite cannot be linked to Whitney Suite; likely linked to ~102 Ma Independence, Bullfrog and Dragon plutons7

Sr-Nd Isotopic Analyses

• Initial 87Sr/86Sr data for four samples show wide range, from 0.7058 to 0.7089
• ΔNd for three samples are more restricted, from -2.7 to -3.0
• RP15-02 (fine-grained Alabama Hills Granite) has no Sm data yet

Data generally agree with O isotope data for 102 Ma rocks in area5 suggesting mantle influence

Implications

• Alabama Hills Granite cannot be part of Whitney Intrusive Suite temporally or isotopically
• Similar in age and isotopic characteristics to plutons to the NW
• Without link to Whitney Suite, block may be offset dextrally relative to main Sierra Nevada batholith
  • Not cut by vertical Golden Bear dike, so must be offset <10 km or up to 28-55 km
• Present location aligns block with plutons of similar age but diverse isotopic characteristics, from crustal (Shaver Suite) to mantle-like (this study)

References


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