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Glaucophane schists and ophiolites of the northern California Coast Ranges: Isotopic ages and their tectonic implications

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Abstract

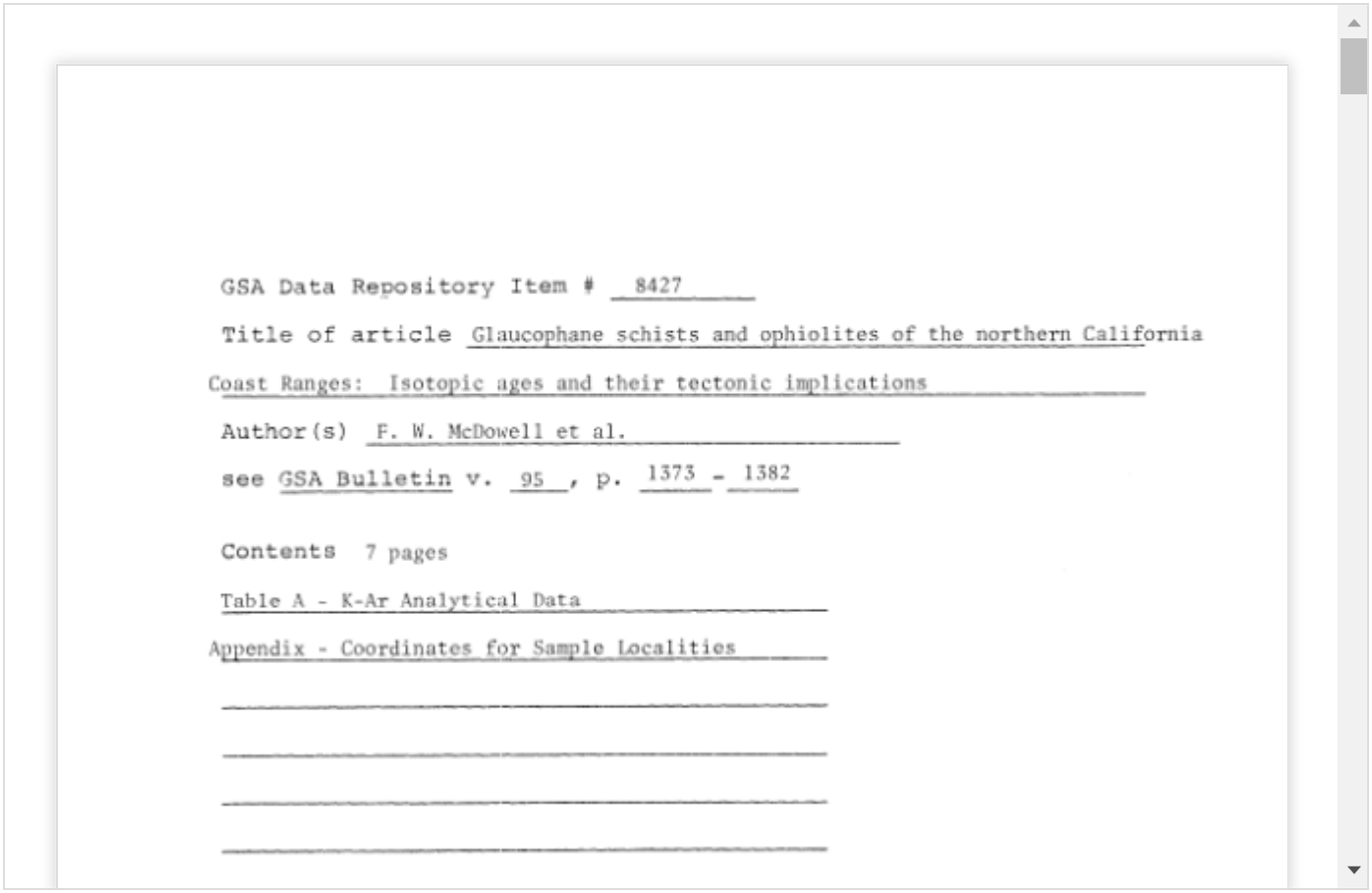
The geology of a strip of 15′ quadrangles across the Franciscan Complex in the Coast Ranges of northern California is the basis for interpretation of the significance of potassium-argon and fossil ages of glaucophane schists, ophiolitic materials, and associated sedimentary rocks. Whole-rock and mineral separates of Franciscan rocks were analyzed, and 69 potassium-argon ages were obtained. White micas and actinolites from blueschist blocks in mélange give apparent ages clustering about 142 and 153 m.y., but they probably represent a continuum. Blue amphibole ages from blocks range from 98 to 151 m.y.; the younger ages are from the eastern portion of the central mélange belt. Published U-Pb ages from the ophiolite belt give crystallization ages from 153 to 165 m.y.; K-Ar ages extend from 143 to 166 m.y. Whole-rock ages from the South Fork Mountain Schist range from 113 to 158 m.y. but cluster around 124 m.y. The association of older K-Ar ages with more coarsely crystalline schist suggests that metamorphism occurred prior to 124 m.y. ago.

Fossil evidence indicates that the basal sediments of the Great Valley Sequence were deposited upon the disrupted Coast Range Ophiolite within 5 to 10 m.y. of the oldest crystallization ages

for ophiolite. Fossils within mélange units, broken formations, and unsubducted trench-slope deposits provide evidence for mélange development by the Early Cretaceous, with youngest mélange units generally lying to the west.

Available chronologic evidence is compatible with a tectonic model involving mélange formation in a restricted flow channel beneath the accretionary wedge of the subduction complex. Upflow of mélange returned blocks of coarsely crystalline metamorphic rocks that were accreted during the initial stages of subduction when the hanging wall was still hot. The viability of this and other proposed tectonic models can be assessed by continued careful field documentation of the nature of contacts between key lithotectonic units and by detailed application of temperature-sensitive geochronologic tools.

Supplemental material: Glaucophane schists and ophiolites of the northern California Coast Ranges: Isotopic ages and their tectonic implications



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Glaucophane schists and ophiolites of the northern California Coast Ranges: Isotopic ages and their tectonic implications

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The geology of a strip of 15′ quadrangles across the Franciscan Complex in the Coast Ranges of northern California is the basis for interpretation of the significance of potassium-argon and fossil ages of glaucophane schists, ophiolitic materials, and associated sedimentary rocks. Whole-rock and mineral separates of Franciscan rocks were analyzed, and 69 potassium-argon ages were obtained. White micas and actinolites from blueschist blocks in mélange give apparent ages clustering about 142 and 153 m.y., but they probably represent a continuum. Blue amphibole ages from blocks range from 98 to 151 m.y.; the younger ages are from the eastern portion of the central mélange belt. Published U-Pb ages from the ophiolite belt give crystallization ages from 153 to 165 m.y.; K-Ar ages extend from 143 to 166 m.y. Whole-rock ages from the South Fork Mountain Schist range from 113 to 158 m.y. but cluster around 124 m.y. The association of older K-Ar ages with more coarsely crystalline schist suggests that metamorphism occurred prior to 124 m.y. ago.

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INTRODUCTION

The northern California Coast Ranges are composed of rocks of the Franciscan Complex, which are predominantly mudstone, siltstone, and graywacke, showing various degrees of metamorphism. Variably metamorphosed bodies of basalt, chert, conglomerate, and serpentinite are widely distributed but volumetrically minor. Mapping on a scale of 1:24,000 by the writers and others of a strip of 15′ quadrangles across the Coast Ranges (Fig. 1) showed that the Franciscan Complex in this area can be subdivided into several tectono-stratigraphic units (see Maxwell and others, 1981). These units range in structural and stratigraphic complexity from relatively undisrupted units, such as portions of the Coastal Belt (Kleist, 1974; Bachman, 1982), to broken formations and mélanges. Along this mapped strip, the tectono-stratigraphic units generally dip and face eastward. They are widely interpreted to represent underthrust and deformed marine sedimentary rocks within an accretionary wedge related to an eastward-dipping Mesozoic subduction zone. Seismic-reflection profiles across the trench slope of some active subduction zones show landward-dipping reflectors consistent with the inferred emplacement mechanism (Beck and Lehner, 1974; Seely and others, 1974; Hamilton, 1979).

Details of the formation and emplacement of blueschist-facies metamorphic rocks in the Franciscan Complex are little understood and remain one of the most controversial aspects of Franciscan geology (Blake and Jones, 1981). Tectonic processes responsible for the upward emplacement of blueschist have been inferred from detailed surface mapping (Worrall, 1981) and numerical modeling (Cloos, 1982). Two principal modes of occurrence of blueschist recognized in the Franciscan Complex of northern California are allochthonous blocks, typically a few tens of metres across, within the mélanges of the central Franciscan belt, and thick slabs tens of kilometres long, such as the South Fork Mountain and Goat Mountain Schists. In general, the coarsely crystalline blocks within

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Additional tabular material for this article may be secured free of charge by requesting Supplementary Data 84-27 from the GSA Documents Secretary.

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Index Terms/Descriptors

absolute age accretion

blueschist facies California

Coast Ranges Cretaceous

dates facies Foraminifera

Franciscan Complex

geochronology

glaucophane schist

Glenn County California

Latitude & Longitude

N39°30'00" - N39°57'00",
W123°30'00" - W122°35'60"

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