DAVID BLOOM

Geologic cross section of the central Klamath Mountains, California: Summary

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INTRODUCTION

A geologic cross section through a part of the central Klamath Mountains, California, depicts the effects of middle Paleozoic through Late Jurassic convergent plate tectonics. This area, which is relatively unintruded by late Mesozoic granitic plutons, contains three of the four Klamath lithic belts or subprovinces originally described by Irwin (1960). The cross section shows that these units compose a stacked structural sequence of thin, subhorizontal plates, separated by eastward-rooting thrust faults of middle Paleozoic and Jurassic age. This summary will treat the chronology of tectonic events in the central Klamaths and the implications of the style of deformation.[1]

TIMING OF TECTONIC EVENTS

Present in the area from higher to lower structural levels are rock units belonging to the eastern Klamath belt, central metamorphic belt and western Paleozoic and Triassic belt of Irwin (1960). Cross section B–B′ (Fig. 1) through a klippe in the Cecilville area shows eastern Klamath sedimentary rocks of diverse lithology lying above serpentinized ultramafic rocks of the Ordovician Trinity complex (455 to 480 m.y. old; Hopson and Mattinson, 1973). Laminated cherts in the eastern Klamath sequence at this locality have been correlated by Davis (1968) with the Silurian(?) Callahan chert (Lindsley-Griffin and others, 1974). To the east of the map area of MC-28I (Davis and others, 1979), more extensive outcrops of Ordovician and Silurian sedimentary rocks of the eastern Klamath subprovince tectonically overlie ultramafic rocks of the Trinity complex (Lindsley-Griffin, 1977; Potter and others, 1977). Recent work (Potter and others, 1977) has suggested that these sedimentary and volcanic strata represent a disrupted island-arc sequence that was initially deposited on the Trinity complex. Tectonitic ultramafic rocks of the Trinity complex are shown at the northeastern end of cross section A–A′ (Fig. 1) where they are intruded by 418 to 439-m.y.-old gabbros (Lanphere and others, 1968) displaying southwest-dipping cumulate layering.

Ultramafic rocks of the Trinity complex have in turn been thrust westward relative to underlying rocks of the central metamorphic subprovince as shown on cross sections A–A′ and B–B′. Central metamorphic units consist of the largely meta-igneous Salmon Hornblende Schist and the largely metasedimentary Grouse Ridge Formation, both of upper greenschist to lower amphibolite facies (Davis and Lipman, 1962). These units were recrystallized during an Early Devonian metamorphic event (380 to 390 m.y. ago; Lanphere and others, 1968). Metamorphic grade of the Salmon and Grouse Ridge units appears to increase upward toward the thrust contact with the Trinity complex, and recrystallization is thought to have been concomitant with deep-seated thrust juxtaposition of the two plates.

The Devonian central metamorphic units, Trinity ultramafic complex, and eastern Klamath rocks comprise the upper plate of the major Siskiyou thrust fault of Davis (1968). These rocks have been displaced westward a minimum of 24 to 32 km relative to lower plate rocks of the western Paleozoic and triassic subprovince as indicated by eastern exposures in windows of the folded thrust fault (see cross section A–A′, Fig. 1). The thrust truncates both early-formed Devonian structures in the central metamorphic upper plate and major antiformal folding of western Paleozoic and Triassic lower plate rocks.

The North Fork antiform of the lower plate (Fig. 1) is a westward-verging, northward-plunging structure cored by a disrupted ophiolitic sequence and flanked by mixed sedimentary units dominated by chert and argillite. The sedimentary units as well as mafic volcanic rocks and interleaved serpentinites appear to have been folded about a core of gabbro and mafic hypabyssal rocks (Ando, 1979). Cherts containing Middle Permian conodonts and Late Triassic Radiolaria (Irwin and others, 1978), along with blueschist olistoliths(?) similar to 220-m.y.-old blueschists from the Yreka area to the north (Hotz and others, 1977) are present on the eastern upright limb of the antiform. This suggests that folding occurred later than 220 m.y. B.P., and certainly later than Late Triassic. Jurassic plutons ranging in age from 152 to 167 m.y. (Hotz, 1971) have intruded the disrupted western limb of the antiform, indicating that the major folding took place within the Jurassic period.

The Siskiyou thrust fault truncates the upright eastern limb of the North Fork antiform and, in eastern parts of the area, is itself folded and intruded by plutons of latest Jurassic age (Fig. 1). Thus, emplacement of the Siskiyou thrust plate appears to have been a Jurassic event.

Depicted also on cross section A–A′ (Fig. 1) is a thrust fault truncating folded rocks of the western Paleozoic and Triassic subprov-

*Deceased.

[1] This article is a summary of "Cross Section of the Central Klamath Mountains, California," Geological Society of America Map and Chart Series, MC-28I; contribution of the Plate Margins Group, U.S. Geodynamics Committee. Contained in MC-28I are a geologic map and cross section, in color, at 1:62,500 scale, a reduced cross section at 1:250,000 scale, magnetic and gravity profiles, and summary text.

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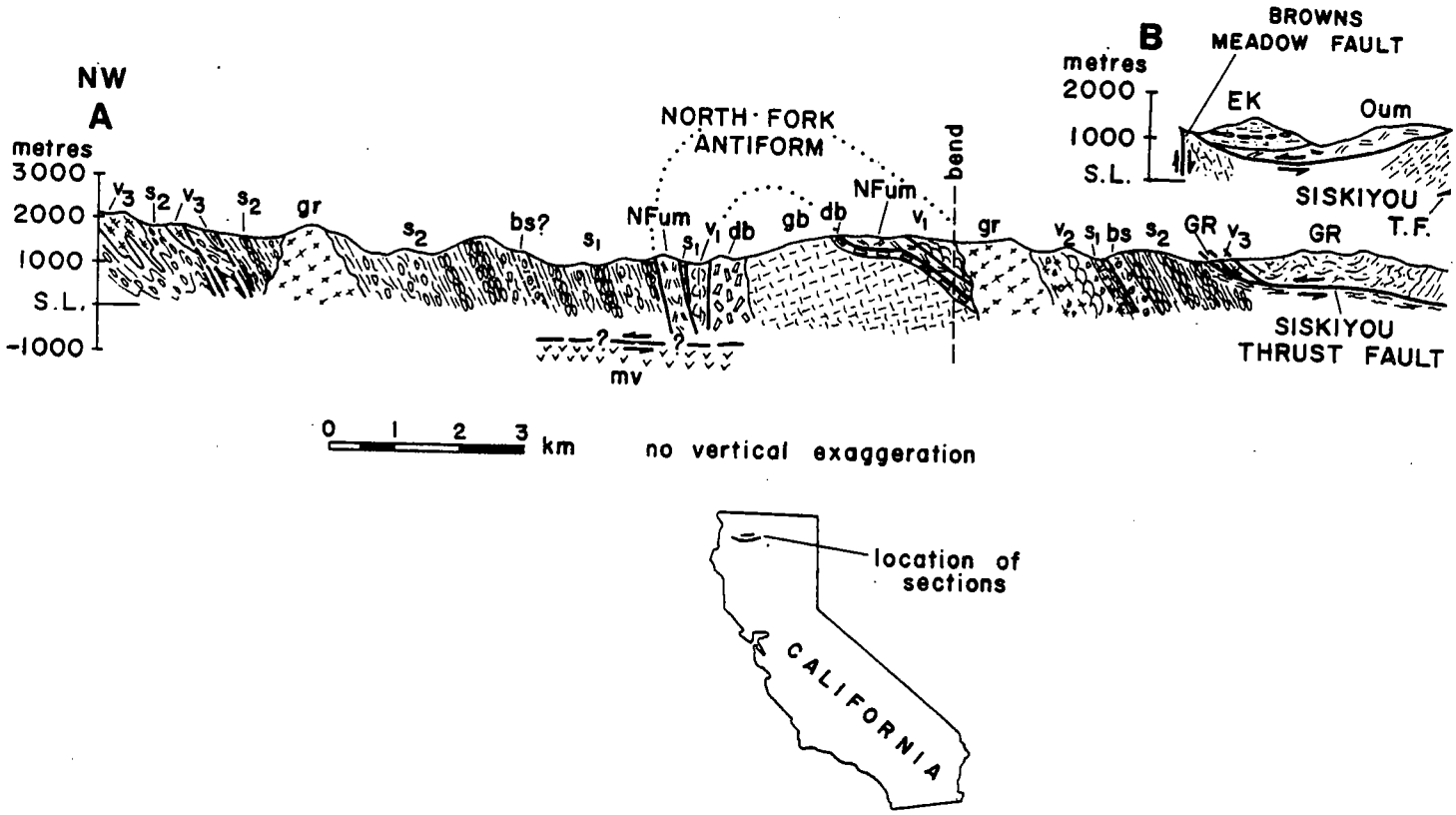

STRUCTURAL SEQUENCE

EK	Rocks of the eastern Klamath subprovince	
Oum	Trinity ultramafic complex (Ordovician?)	
GR	Grouse Ridge Formation	central metamorphic subprovince
S	Salmon Hornblende Schist	

ROCKS BELOW THE SISKIYOU THRUST FAULT

v_3	Higher volcanic unit	western Paleozoic and Triassic subprovince
s_2	Higher sedimentary unit	
bs	Blueschist zone (olistostromal?)	
s_1	Lower sedimentary unit (Upper Triassic)	
v_2	Middle volcanic unit	
NFum	North Fork ultramafic rocks	
v_1	Lower volcanic unit	
db	Mafic hypabyssal rocks	
gb	Gabbro	
mv	Metavolcanic unit	

ROCKS NOT IN STRUCTURAL SEQUENCE

gr	Granitic rocks

Figure 1. Simplified geologic cross section of the central Klamath Mountains, showing major lithic assemblages and structural features.

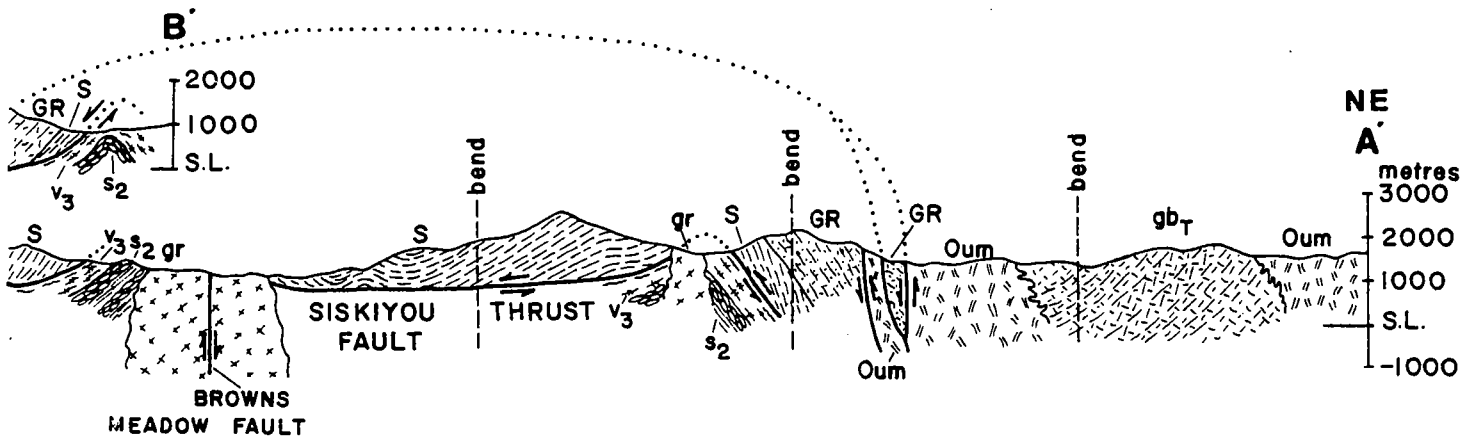

Figure 1. ***(Continued).***

ince at depth. This interpretation is based on a study by Cox (1967) which shows a subhorizontal thrust fault in the Trinity River canyon south of the line of cross section A–A'. The thrust separates steeply dipping low-grade upper-plate rocks of the western Paleozoic and Triassic subprovince from lower-plate mylonitic and amphibolitic rocks of higher grade. These lower-plate rocks (Logan Gulch complex of Cox, 1967; Hayfork Bally meta-andesite of Irwin, 1977) include actinolite schist, massive hornblendite, metaporphyry, mylonitic layered amphibolite, garnet amphibolite gneiss, and pelitic and siliceous metasedimentary rocks.

IMPLICATIONS OF THE CENTRAL KLAMATH MOUNTAINS

Several important conclusions can be reached regarding equivalency of lithic assemblages and structural style in the central Klamath Mountains. The sedimentary section west of the core of the North Fork antiform correlates with the Hayfork terrane of Irwin (1972), and the mafic core rocks and eastern sedimentary section correlates with his North Fork terrane. We interpret the chert and argillite section on the western limb of the antiform as the probable repetition of the chert and argillite section of the eastern limb, implying equivalency of the North Fork and Hayfork terranes. Alternatively, Irwin (1972, 1977) has suggested that North Fork rocks are separated from Hayfork rocks by a major east-dipping thrust fault.

Irwin (1974, 1977) regarded the Hayfork Bally meta-andesite as the lower stratigraphic unit of the Hayfork terrane. We, in turn, interpret the Hayfork Bally (Logan Gulch complex of Cox, 1967) as being separated from upper Hayfork units by a low-angle fault and suggest that the higher-grade lower-plate rocks may correlate with units of the Rattlesnake Creek terrane exposed farther to the west.

Considering the relatively small area discussed, it is noteworthy that the eastern Klamath subprovince, Trinity ultramafic complex, central metamorphic subprovince, and the western Paleozoic subprovince exist as thin thrust-fault–bounded subhorizontal sheets present at high structural levels in the central Klamath Mountains. Because the aggregate structural thickness of these units is less than 3 km, and they apparently extend to depths no greater than sea level, the question arises as to what rock units compose the remainder of the continental crust below the Klamath Mountains. Even taking into account the possibility that rocks of the western Jurassic subprovince may lie structurally beneath the stacked units seen on the cross section, it appears that pre-Tithonian units are present only as a thin veneer at highest structural levels in the central Klamath Mountains. The remainder of the crustal section must, therefore, consist of materials accreted by underthrusting during post-Jurassic time.

Davis and others (1978) have proposed that Middle(?) and Late Jurassic thrust faults in the central Klamath Mountains do not represent fundamental plate boundaries between exotic oceanic assemblages that collided during Jurassic time. This interpretation is followed here, and the suggestion is made that these thrusts are an expression of internal imbrication of a complex Klamath arc that developed during Middle(?) and Late Jurassic convergence of the Pacific and North American plates. The observed structures appear to be confined to the upper plate and it is doubtful that the east-dipping subduction zone, which was somewhere to the west during plate convergence, is preserved in the geologic record.

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