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Eocene Megafossils from the Needles–Gray Wolf Lithic Assemblage of the Eastern "Core Rocks", Olympic Peninsula, Washington

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INTRODUCTION

The central part of the Olympic Mountains, Washington, contains several lithic assemblages that collectively make up what is known as the "core rocks", a term that stems from usage in the 1970s by U.S. Geological Survey mappers. These core rocks have had a complex tectonic history, and it is generally accepted that they are a collage of several imbricated thrust slices consisting of subduction-related mélange and turbidite units that accreted to North America during the Tertiary (Heller and others, 1992; Suczek and others, 1994). Due primarily to the scarcity of fossils, the ages of the core rocks are not well constrained (Heller and others, 1992), but they are generally accepted to be younger than the lower part of the so-called "peripheral rock" (that is, lower part of the Crescent terrane) that border them to the north, east, and south in a horseshoe outcrop pattern.

Fossils are rare within the core rocks (Danner, 1955b; Tabor, 1975). Reasons for this scarcity are that many of the core rocks are turbidites, originally deposited in deep water as the result of turbidity flows. Turbidity flows are, in most instances, not conducive to the preservation of fossils. Many turbidites in the core rocks have also been sheared or otherwise deformed, and some are metamorphosed, destroying any fossils that may have been present.

The Needles–Gray Wolf lithic assemblage, the easternmost of the core rocks, consists of an approximately 6.5 km-thick thrust slice containing sandstone, siltstone, slaty mudstone, and pillow basalt. The dip of this thrust slice is nearly vertical, and the unit is also chiefly eastward and northeastward topping (Cady and others, 1972a) and is one of the structurally highest thrust slices in the accretionary prism that makes up the Olympic core. The Needles–Gray Wolf lithic assemblage is one of the oldest thrust slices, yet it is younger than the lower to middle Eocene pre-subduction zone rocks in the lower part of the Crescent terrane. The Needles–Gray Wolf unit was originally reported (see Previous Work) as ranging in age from late Paleocene to late Eocene, on the basis of scarce megafossil remains. Fission-track studies of detrital zircons in sandstones (Brandon and Vance, 1992a,b) now place the age range from 39 to 33 Ma (late Eocene to early Oligocene). The stratigraphic positions of these detrital-zircon samples versus those of the megafossils are discussed under Previous Work.

This is the first detailed report about the megafossil species in the Needles–Gray Wolf unit. We offer comments regarding provenance, geologic age, and photographic documentation of the species collected. The molluscan stages used in this report stem from Clark and Vokes (1938), who proposed five informal molluscan-based provincial Eocene stages: Meganos, Capay, Domengine, Transition, and Tejon.

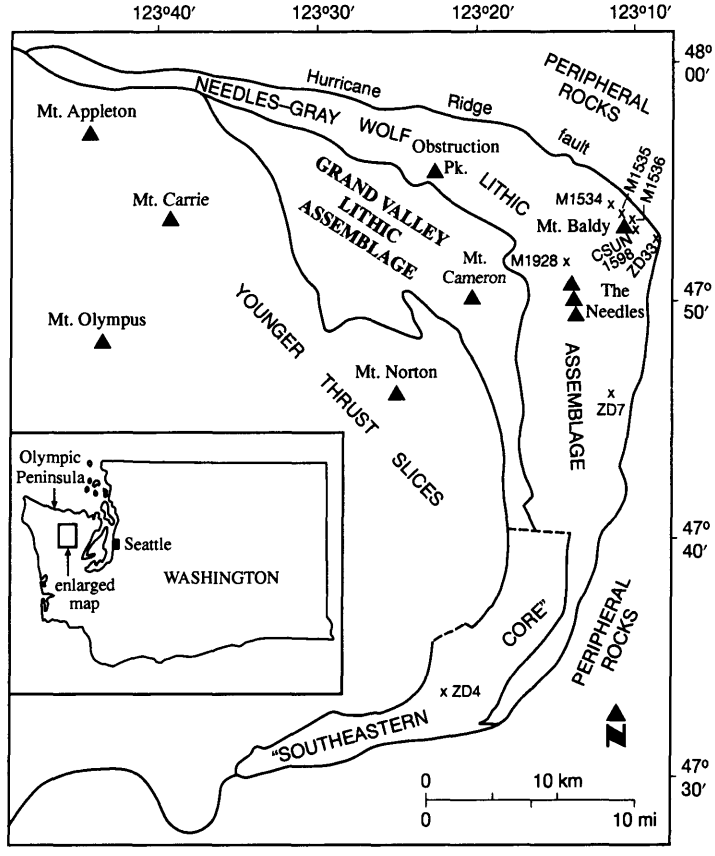

Figure 1. Index map showing the megafossil localities and selected detrital-zircon localities of Brandon and Vance (1992a,b). Modified from Tabor and Cady (1978a, fig. 2).

Abbreviations used are: CSUN, California State University, Northridge; LACMIP, Natural History Museum of Los Angeles County, Invertebrate Paleontology Section; USGS, U.S. Geological Survey; and USNM, National Museum of Natural History, Washington, D.C.

PROCEDURE

The Needles–Gray Wolf megafossils we studied are from five localities. Four of these localities (USGS locs. M1534, M1535, M1536, and M1928) were found and collected by W. M. Cady and his colleagues while mapping for their report on the Tyler Peak quadrangle (Cady and others, 1972a). Localities M1534–1536 are from near Mount Baldy in the upper part of the Needles–Gray Wolf lithic assemblage (Fig. 1).

Locality M1928 is about 6.5 km southwest of the other localities and is north of The Needles, which is a high, steep-sided ridge where rocks of the Needles–Gray Wolf lithic assemblage are prominently exposed. We did not visit the Cady localities; they are remote and extremely difficult to reach. We borrowed the collections of megafossils, which number about 100 specimens, from the USGS at Menlo Park, Calif.

The fifth locality (CSUN loc. 1598) was found by the junior author in 1992. A blizzard in August allowed for only a short visit, but seven fossil specimens were collected.

Preservation of all the fossils from the Needles–Gray Wolf unit is poor, and many specimens are preserved as molds. Latex peels of external molds (made by workers at the USGS and by us) were used to identify the gastropods and some of the bivalves.

The specimens illustrated in this report are deposited at USNM, and the rest of the collection is stored at the USGS (Menlo Park).

PREVIOUS WORK

Cady and MacLeod (1963) reported fragments of megafossils from a fossiliferous horizon in the core of the Olympic Mountains. The interval is 150 to 300 m thick and crops out locally for about 34 km along strike. They also mentioned the presence of the gastropod *Gemmula*? sp. and the bivalves *Acila* cf. *A. decisa* (Conrad, 1855) and *Crassatella?* sp. They further mentioned that W. O. Addicott, who was a molluscan paleontologist with the USGS at that time, had examined the megafossils and considered them to be of early Tertiary (Paleocene to Eocene) age. These fossil molds and casts of fragmentary remains are from three USGS localities (M1534, M1535, M1536) that were plotted within the Needles–Gray Wolf lithic assemblage by Cady and others (1972a) on their geologic map. The localities are in a thin zone of microbreccia in the Mount Baldy area. Cady and others (1972a) also indicated megafossils from the microbreccia at about 5.5 km and about 8.5 km south of Mount Baldy but gave no locality numbers.

Cady and others (1972a) reported planktonic microfossils from a microfossil locality (USGS 3816) 3 km southeast of locality M1928. The reported age of the microfossils as "not older than Tertiary" is not very informative and makes any information gained from megafossils more important. Cady and others (1972a) assigned a minimum age of 42.6 ±0.7 Ma. (late Eocene) to the Needles–Gray Wolf lithic assemblage on the basis of a K-Ar age from a dike that cuts the assemblage about 45 km southwest of the Mount Baldy area.

Cady and others (1972b), Tabor and others (1972), and Tabor and Cady (1978a) reviewed the probable geologic age of the Needles–Gray Wolf rocks but added no new megafossil information. Tabor (1975, fig. 22) provided generalized line drawings of unnamed species of the bivalve *Venericardia* and the gastropod *Turritella* from near locality M1928. He reported that W. O. Addicott considered these fossils to be probably late Eocene in age. Tabor and Cady (1978b) plotted the four above-mentioned USGS mega- fossil localities on their geologic map of the Olympic Peninsula, but they did not list or discuss the megafossil species, nor did they give a precise geologic age. They assigned the Needles–Gray Wolf unit an undifferentiated Eocene age.

Brandon and Vance (1992a,b) reported fission-track ages in the range of 39 to 33 Ma (late Eocene to late Oligocene) for the youngest detrital zircons in two sandstone samples (ZD7 and ZD33) (Fig. 1) from the Needles–Gray Wolf unit. Sample ZD7 was collected about 10.5 km (6.5 mi) south of USGS loc. M1928 and might be stratigraphically higher. Sample ZD33 is 3.2 km (2 mi) southeast of localities USGS M1536 and CSUN 1598 and is from the stratigraphically highest (youngest) part of the Needles–Gray Wolf unit.

Brandon and others (1988) reported a fission-track age of 39 ±4.5 Ma (late Eocene) for the youngest detrital zircons in a sandstone sample (ZD4) (Fig. 1) collected from the Southeastern core rocks (map unit Tsc of Tabor and Cady, 1978b) along the North Fork Skokomish River. The northernmost outcrops of the Southeastern core rocks are about 21 km (13 mi) south of the southernmost megafossil locality in the Needles–Gray Wolf unit. The stratigraphic relations of the Southeastern core rocks and the Needles–Gray Wolf unit are complex and need further study.

The only other megascopic fossils reported from the Needles–Gray Wolf lithic assemblage are large (as much as 8.5 mm diameter) siliceous tubes of a foraminiferid. Danner (1955a,b) reported the tubes as present near Obstruction Peak [his Obstruction Point], which is about 15 km northwest of Mount Baldy (Fig. 1). Obstruction Peak is underlain by rocks of the Needles–Gray Wolf lithic assemblage (Tabor and Cady, 1978b). In 1975, Danner referred to the fossils as the agglutinated tube fossil *Terebellina* and noted that they indicate relatively deep offshore waters. Miller (1995) confirmed that the tubes are actually remains of the siliceous, large foraminiferid *Bathysiphon* and that the genus name *Terebellina* is a junior synonym. However, remains of this foraminiferid, which are also present in the peripheral rocks surrounding the core rocks, are not age diagnostic.

LITHOLOGIES AND PALEONTOLOGY

Rocks from USGS loc. M1928 are dark-gray, well-cemented, very fine grained and well-sorted micaceous sandstone that is brown when weathered. The rock is slightly metamorphosed and contains some deformed gastropods and bivalves. Some of the hand specimens contain localized concentrations of disarticulated bivalve shells that show both concave-up and concave-down positions. The shells are matrix supported and were deposited by grain-flow processes associated with turbidites, which make up most of this rock assemblage.

Seventy-six fossil specimens were collected at locality M1928, and the taxonomic composition of this fauna is listed in Table 1. Taxa identifiable to genus level or lower are illustrated in Figure 2. The dominant faunal components are the gastropod *Turritella uvasana* cf. *T. uvasana uvasana* Conrad, 1855, and the bivalve ?*Callista andersoni* (Dickerson, 1915). Most of the gastropods are preserved as external molds, and the *Turritella uvasana* cf. *T. uvasana uvasana* remains consist

Table 1. Megafossils from USGS loc. M1928 in the western part of the Needles–Gray Wolf lithic assemblage, eastern core of the Olympic Mountains. The number of specimens of each species is given in parentheses

Gastropods
Turritella uvasana cf. *T. uvasana uvasana* Conrad (11)
Crepidula? sp. (1)
naticid (1)
unidentifiable gastropods (11)
Bivalves
Glycymeris sp. (3)
Venericardia sp. indet. (1)
?*Callista andersoni* (Dickerson) (16)
?*Callista conradiana* (Gabb) (5)