

## *Age of the Elkhorn Ridge Argillite, Northeastern Oregon*

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**I**N NORTHEASTERN OREGON there are extensive exposures of pre-Tertiary rocks whose age and stratigraphic relations are uncertain. The Elkhorn Ridge argillite (Gilluly, 1937, p. 14) has been included among the Paleozoic formations of doubtful age, and this paper presents evidence for a more precise dating of this formation.

Geologic studies in progress since 1949 have shown that strata included in the Elkhorn Ridge argillite can be traced almost continuously for seventy miles from the vicinity of Lookout Mountain westward to the Greenhorn Mountains. The best exposures for structural and stratigraphic studies are northeast of Sumpter in the Elkhorn Mountains where vigorous alpine glaciation has carved many cirques. The entire formation has been strongly compressed into folds that are essentially isoclinal, and, although intense faulting complicates determinations of thickness, Gilluly's (1937, p. 14) estimate of five thousand feet is conservative.

In lithology the Elkhorn Ridge argillite is extremely variable, ranging in composition from chert and interbedded limestone lenses to tuffs and thin volcanic flows. Characteristically the formation is fine grained, and beds of the coarseness of sand or conglomerate are seldom encountered. The most abundant rock is siliceous argillite, but pyroclastic and chert beds are sufficiently widespread to be very significant in quantitative considerations. Although the Elkhorn Ridge argillite can be locally subdivided into rather indefinite lithologic units that may be traced for several miles, correlations with other and more distant exposures are impractical because of structural complications, lack of diagnostic horizons, and absence of possible guide fossils. For these reasons it seems advisable to continue treating the Elkhorn Ridge argillite as a single formation.

On his geologic map of the Baker quadrangle, Gilluly (1937, pl. 1) gave the Elkhorn Ridge argillite a Pennsylvanian (?) age from fusulinids collected by Pardee (Pardee and Hewett, 1914, p. 35) in the adjoining Sumpter quadrangle. In a forty-mile east-west belt, which includes many excellent exposures in the Elkhorn Mountains, the writer found no fossil material except a few crinoid stems. Hence an attempt was made to locate the original fusulinid

locality of Pardee. Specimens from this locality (Fig. 1) were obtained and identified as Permian by M. L. Thompson (personal communication, 1953). According to Thompson, the fusulinids are probably Leonardian.

The fusulinid limestone is in the Sumpter quadrangle in sec. 8, T. 10 S., R. 37 E. The Sumpter Valley narrow-gauge railroad formerly crossed this area of low hills, and the fusulinids are exposed in the southwest side of a shallow cut in the abandoned roadbed. No limestone outcrops were found in the immediate vicinity except those present in the railroad cut. From these poor exposures it appears as if the fossiliferous limestone lense is about thirty-five feet thick. The nearly vertical dipping strata have an approximate strike of N 70° W, which is within the range of common variation from the general east-west regional trend.

Age determination of the fusulinids, in conjunction with regional Pacific Coast stratigraphic relations, are believed sufficient evidence to assign a Permian age to all the strata included by Gilluly in the Elkhorn Ridge argillite. A formation as thick as the Elkhorn Ridge argillite conceivably could include rocks of several geologic periods, but this possibility is considered unlikely. Structural interpretations indicate that at least two thousand feet of the Elkhorn Ridge argillite are stratigraphically above the fusulinid limestone. These overlying sediments and the remainder of the formation underlying the fusulinid limestone are intruded by an ultramafic suite that ranges from dunite to gabbro. Investigations by T. P. Thayer (personal communication, 1953) in the Strawberry and Aldrich Mountains of east-central Oregon indicate that the ultramafics and associated gabbro are post-Permian and pre-Upper Triassic. The sediments above the fusulinid limestone probably do not include Lower Triassic or Middle Triassic because rocks of these ages are absent in the thick Triassic sections of northeastern Oregon (Smith, et al., 1941, pp. 8-14) and east-central Oregon (Nesbit, 1951, pp. 28-30) while the Lower Triassic characteristically is absent along the west coast of North America. Therefore, the entire thickness of Elkhorn Ridge argillite overlying the fusulinid limestone is probably Permian.

A Permian age is given with somewhat less certainty also to that portion of the formation that underlies the fossiliferous limestone. However, the base of the Elkhorn Ridge argillite has not been found nor have the strata anywhere been observed in contact with older formations. The Elkhorn Ridge argillite is the basement rock throughout the Elkhorn Mountains and probably also in the eastern part of the Greenhorn Mountains. Seventy miles to the southwest, Pennsylvanian and Mississippian sediments are present in east-central Oregon (Merriam and Berthiaume, 1943, pp. 149-156), but these formations

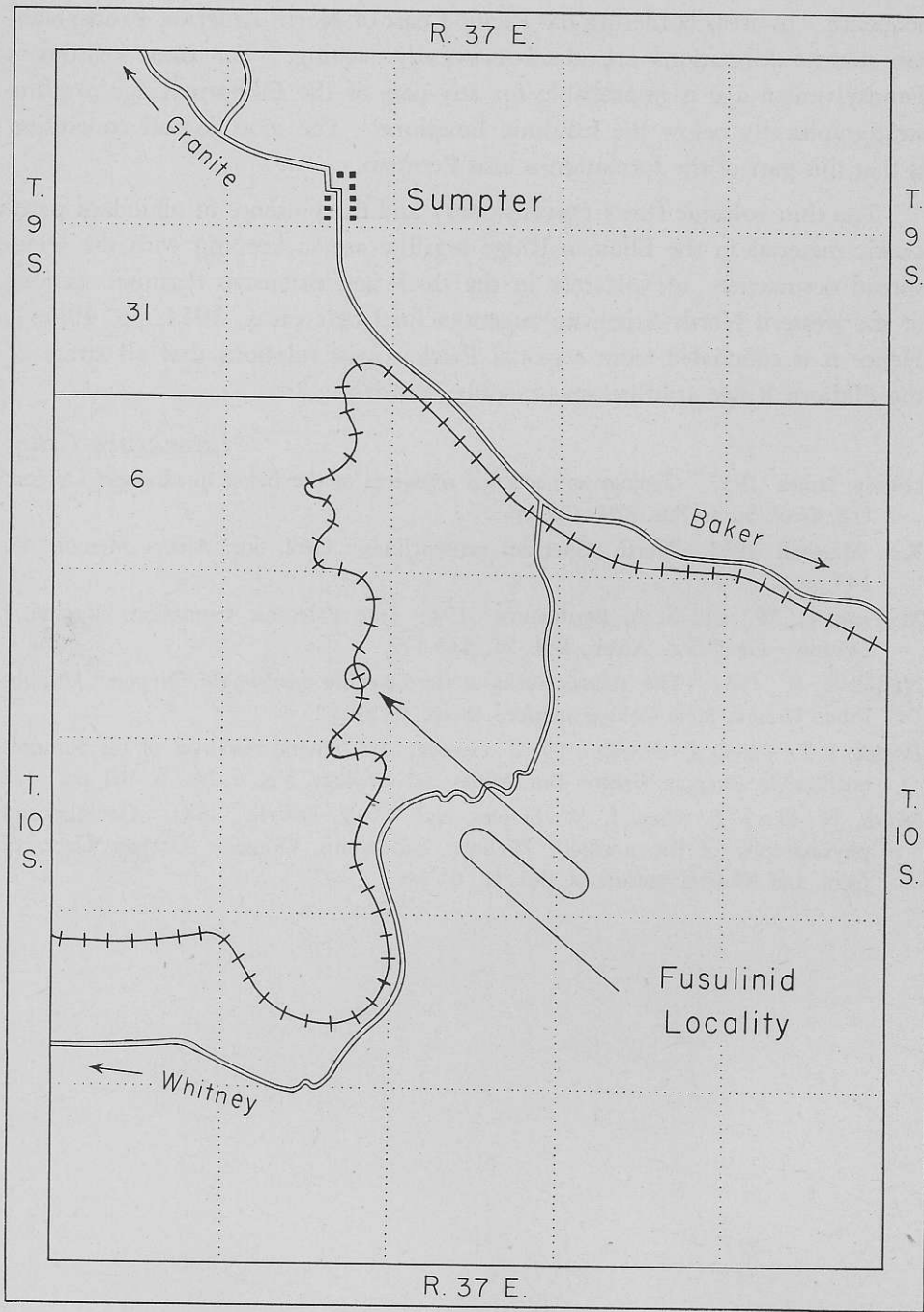


Figure 1. Location of the fusulinid deposit

are largely continental and bear no resemblance to the marine Elkhorn Ridge sequence. In areas bordering the Pacific Coast of North America, Pennsylvanian marine formations are characteristically lacking. For these reasons a Pennsylvanian age is improbable for any part of the Elkhorn Ridge argillite stratigraphically below the fusulinid limestone. The most logical conclusion is that this part of the formation is also Permian.

The thin volcanic flows (greenstones) and the presence of abundant pyroclastic material in the Elkhorn Ridge argillite are in keeping with the widespread occurrence of volcanics in the thick and extensive Permian sections of the western North American eugeosynclinal belt (Kay, 1951, pp. 40-43). Hence it is concluded from regional Pacific Coast relations that all strata of the Elkhorn Ridge argillite are probably Permian.

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