Tonsteins from New Mexico- touchstones fro dating coal beds

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TONSTEINS FROM NEW MEXICO—TOUCHSTONES FOR DATING COAL BEDS

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Isotopic dating has had its greatest application in dating igneous events and defining periods of metamorphism. Isotopic dating of sedimentary rocks has been relatively minor—limited mainly to glauconites, which are not very reliable chronometers (Obradovich, 1965; Morton and Long, 1984). The prominent exception to this bland record has been the dating of widespread volcanic ash layers interbedded with sedimentary rocks. These ash layers are isochronous and are used as marker beds in the stratigraphic column (Izett and others, 1970; Obradovich and Cobban, 1975; Izett, 1981). Tonsteins (Williamson, 1970) are diagenetically altered equivalents of volcanic ash layers that have been preserved in peat swamp environments and can be quite useful for stratigraphic problems involving coal beds (Ryer and others, 1980). Thus they can be used for isotopic dating in the same way as their equivalents in marine rocks (bentonites) or recent unaltered volcanic ashes. Generally, American coal geologists have made less use of tonsteins in their investigations than have their European counterparts (Spears and Kanaris-Sotiriou, 1979; Burger and others, 1984), probably because the volcanic origin of tonsteins has not been widely recognized in this country. However, tonsteins have been successfully used to isotopically date coal beds in Alaska and Washington (Triplehorn and others, 1977; Turner and others, 1980; Triplehorn and Turner, 1982; Turner and others, 1982; Triplehorn and others, 1984).

This paper gives the results of K-Ar dating of sanidine from a tonstein bed within the first coal bed above the Pictured Cliffs Sandstone in the Fruitland Formation, San Juan County, in northwestern New Mexico. Two outcrop locations were sampled, some 15 miles apart along depositional strike. At two of the outcrops (near Bisti Trading Post), the coal bed contained two tonsteins, one near the base and the other near the top of the 2.5-meter-thick coal bed; only the top tonstein was analyzed. At the other outcrop, only one tonstein bed was visible near the top of the coal bed; the base of the coal was covered. All of the tonstein layers were about the same thickness (18–20 cm) and contained accretionary lapilli (Bohor and Triplehorn, 1984). The tonsteins contained smectite and minor kaolinite.

The K-Ar dates range from 76.3 to 77.3 m.y., a very compact grouping of ages over this geographical sampling distance. The lowest Fruitland coal bed is thus late Campanian (Harland and others, 1982) at these outcrops. (According to Reeside [1924], the Pictured Cliffs Sandstone is age transgressive; thus the age of the first coal bed formed above it varies throughout the San Juan Basin). The ages reported here agree well with other geologic age assessments (Bauer, 1916; Reeside, 1924), although these other assessments are not as specific as these K-Ar dates. It would appear that tonsteins could be of considerable value in dating and correlating coal beds within Mesozoic and Cenozoic strata (as has been done in Alaska and Washington), and possibly Paleozoic strata (Lippolt and others, 1984).

These tonstein samples were collected by B. F. Bohor and D. M. Triplehorn of the U.S. Geological Survey. Sample preparations and analytical analyses were performed in the U.S. Geological Survey laboratories at Denver, Colorado. Mineral concentrates were obtained using standard mineral separation techniques. No attempt was made at beneficiating the sanidine concentrates by handpicking.

Potassium analyses were performed by E. H. Berndt, using a lithium metaborate flux fusion-flame photometry method with lithium as an internal standard (Ingamells, 1970). Argon extraction and purification techniques were similar to those described by Dalrymple and Lanphere (1969). Argon composition was determined by standard isotope dilution procedures using a 60-sector, 15.2-cm-radius, Nier-type mass spectrometer. The estimated analytical uncertainty for the calculated age is reported as 2σ. The decay constants used in the age calculations are: $\lambda_\beta = 4.962 \times 10^{-10}\ yr^{-1}$; $\lambda_\epsilon = 0.581 \times 10^{-10}\ yr^{-1}$; and $^{40}K/\Sigma K = 0.01167$ atomic percent (Steiger and Jager, 1977).

SAMPLE DESCRIPTIONS

1. *DMT80-66* K-Ar
Tonstein (36°15′15″N,108°17′W; T23N,R14W; whitish, upper tonstein layer in first coal bed of Fruitland Formation [Cretaceous] above Pictured Cliffs Sandstone; Bisti Trading Post 7.5′ quad., San Juan Co., NM). *Analytical data:* K_2O = 6.95%, 7.04%; $^{40}Ar^* = 7.949 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 85%.
(sanidine) 77.2 ± 2.8 m.y.

2. *DMT80-64* K-Ar
Tonstein (36°15′15″N,108°18′W; T23N,R14W; whitish, upper tonstein layer in first coal bed of Fruitland Formation [Cretaceous] above Pictured Cliffs Sandstone; Bisti Trading Post 7.5′ quad., San Juan Co., NM). *Analytical data:* K_2O = 7.38%, 7.37%; $^{40}Ar^* = 8.386 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 94%.
(sanidine) 77.3 ± 2.9 m.y.

3. *DMT80-60* K-Ar
Tonstein (36°18′N,108°31′W; T24N,R16W; whitish tonstein layer in first coal bed of Fruitland Formation [Cretaceous] above Pictured Cliffs Sandstone; Newcomb SE 7.5′ quad., San Juan Co., NM). *Analytical data:* K_2O = 7.54%, 7.55%; $^{40}Ar^* = 8.467 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 96%. *Comment:* Coal bed overlain by channel sandstone.
(sanidine) 76.3 ± 2.7 m.y.

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