A Fission-Track Study of the Terrigenous Sedimentary Sequences of the Morrison and Cloverly Formations in the Northeastern Bighorn Basin, Wyoming

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ABSTRACT

Volcanic input into the Morrison and Cloverly formations of the northeastern Bighorn Basin is represented as numerous air-fall facies including bentonites and lapilli (?) tuffs as well as volcanic mudflows and tuff beds in various states of diagenetic alteration. Results of the fission-track dating of zircons from rocks collected from several of these northeastern Bighorn Basin facies are presented in this paper. The top of the Little Sheep Mudstone Member of the Cloverly Formation is dated at 115 ± 10 Ma. Ages of some local guide beds, such as the Old Shell diamictite (129 ± 16 Ma) and a resistant gray-white diamictite in the southwest of the Sheep Mountains (115 ± 8 Ma), were also established to constrain a magnetic polarity stratigraphy study in progress.

No overall significant fission-track annealing was identified in the zircon sets in this study. This suggests relatively shallow burial (perhaps <5 km) of the post-Cloverly sediments and/or a relatively stable geothermal gradient in this area over geologic time.

INTRODUCTION

The Morrison and Cloverly formations of the Bighorn Basin (Fig. 1) and adjacent areas in the Central Rocky Mountains have long stimulated people’s interest. They are significant not only because they contain a prolific dinosaur fauna and uranium deposits, but also because they have contributed toward understanding the early developmental history of the Cordilleran foreland basin from late Jurassic to early Cretaceous time (MacClintock, 1957; Suttner, 1969; Furer, 1970; Ostrom, 1970; Geigengack et al., 1985; Chen, 1989). Previous work has primarily centered on the petrology and sedimentary environments of these rocks (Darton, 1904; Yen, 1952; Moberly, 1956, 1960; Mirsky, 1962; Wiltschko and Dorr, 1983; Kvale, 1986). This has allowed for an understanding of the sedimentary response to regression of the Middle Jurassic Sundance Sea and the subsequent onset of extensive subaerial conditions coincident with initiation of the craton-directed thrusting from the west.

There still remains, however, some uncertainty as to the timing and distribution of intra-foreland deformation, thought to have occurred throughout the portion of the Rockies foreland basin by the Laramide orogeny beginning in the latest Cretaceous. Sedimentologic evidence has been collected (de Celles et al., 1986), and some representative age-values have been defined (Douglass, 1984; Christiansen, 1987; Ambardar and Vondra, 1989; Swirc et al., 1989; Chen, 1989; Swirc and Johnson, 1990, 1995) that suggests some form of structural partitioning of the Rockies foreland basin began as early as the start of the Cretaceous.

On the basis of these new data, a fission-track analysis of the Morrison and Cloverly formations was attempted for two primary purposes: 1) to date mineral zircons found within certain tuff horizons and associated sandstone beds in these two stratigraphic units within the Bighorn Basin; and 2) to understand the framework of the post-depositional geothermal history of a portion of the basin. This study is important not only as a source of data for detailed stratigraphic correlation, but also for the delineation of the sedimentary facies variation, which reflects the interactive relationship between inter- and intra-foreland tectonism and sedimentologic processes.

BACKGROUND GEOLOGY

The Upper Jurassic Morrison and Lower Cretaceous Cloverly formations of the Bighorn Basin are part of an extensive non-marine sedimentary sequence found throughout the Western


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