U.S. Geological Survey Miscellaneous Field Studies Map MF-2382

REGIONAL STRATIGRAPHIC CROSS SECTIONS OF CRETACEOUS ROCKS FROM EAST-CENTRAL ARIZONA TO THE OKLAHOMA PANHANDLE

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2002

Version 1.0

Manuscript approved for publication November 1, 2001

INTRODUCTION

Sedimentary rocks of Cretaceous age along Transect D-D" in eastern Arizona, northern New Mexico, southern Colorado, and western Oklahoma consist mainly of sandstone, siltstone, shale, limestone, and bentonite. They accumulated as sediments in continental, nearshore marine, and offshore marine environments on the west side of a north-trending epicontinental sea. The rocks record intermittent deposition and erosion as well as regional and local subsidence and uplift possibly beginning in Aptian time (about 121-112 Ma) and occurring in Albian through Maastrichtian time (about 112-65.4 Ma). Most of the Lower Cretaceous (Berriasian through Aptian, 142-112 Ma) in this transect is represented by a basal unconformity. The Cretaceous rocks and unconformities along the transect are depicted on the attached lithostratigraphic cross sections (sheets 1 and 2); one extending from the Mogollon Rim in eastern Arizona to Pagosa Springs in southwestern Colorado and the other from Pagosa Springs, Colorado, to Kenton in western Oklahoma. The same rocks and unconformities are also represented on the attached chronostratigraphic profile (sheet 3), which was prepared mainly from surface and subsurface data shown on the lithostratigraphic cross sections.

This compilation is the third in a series that was prepared for the Western Interior Cretaceous (WIK) Project of the Global Sedimentary Geology Program (GSGP), established by the International Union of Geological Sciences. WIK was identified early as a GSGP research project with the goal of extending our understanding of the history of the earth, surficial processes, the evolution of life, and the biotic influences on earth processes through global-scale research on sediments, sedimentary rocks, and the contained organisms and their remains. A specific goal of WIK has been to create a publicly available database from which to reconstruct and interpret the depositional

history of the Cretaceous in the interior of western North America. The database would allow comparisons of the Cretaceous Western Interior Basin with other basins of the world in order to test global process controls and concepts such as eustacy and sequence stratigraphy. The WIK project received early support from geological organizations within companies, governments, and academia, and from individuals. Research activities have been driven primarily by the many volunteers who shared their data with WIK. The project and the component cross sections were described initially by Dyman and others (1994) who published small scale versions of the cross sections. Transect A-A', described in more detail by Dyman and others (1995), extends irregularly eastward from southwestern Montana to southwestern Minnesota. The cross section for transect B-B', expanded by Merewether and others (1997), trends east-northeast from northeastern Utah to south-central South Dakota. The cross section along Transect C-C', from central Utah to western Kansas, has not been revised; an early version at larger scale is available in Molenaar and Rice (1988).

The regional cross sections, A-A', B-B', and D-D", vary slightly in format and scale because of the preferences of the regional coordinators and because of the specific geologic requirements of each region. Correlations of stratigraphic units along the transects were based mainly on conspicuous beds of bentonite and marine fossils in the sequences. The datum used in the lithostratigraphic cross sections for transects A-A' and B-B' was derived from the stratigraphic locations of the upper Campanian mollusk Baculites reesidei. For the lithostratigraphic cross section of transect D-D", Molenaar (Dyman and others, 1994) explained that "A variable datum was used in constructing the lithostratigraphic cross section. In general, the highest marker bed or horizon in a particular area that was considered to have been nearly horizontal at the time of deposition was used. For example, in the southwestern part of the transect, either the Twowells Tongue of Dakota Sandstone or the Rio Salado Tongue of Mancos Shale was used because most of the overlying strata had been removed by erosion.

Farther northeast where younger strata are preserved, a higher marker bed was used, such as the base of the Pescado Tongue of Mancos Shale or a marker in the Satan Tongue of the Mancos Shale and so on." The numerical ages of the strata, shown on the chronostratigraphic cross sections, were determined from the radiometric studies of bentonites by Obradovich (1993) and the identification of associated fossils by Cobban (summarized in Cobban and others, 1994). The time lines are as drawn by Molenaar.

The cross sections for Transect D-D" were compiled by the late C.M. Molenaar from stratigraphic information that he and other earth-scientists developed during many years of field and subsurface studies in the southwestern United States. They are based on published and unpublished information as follows, from southwest to northeast. The data for east-central Arizona and the southern part of the Zuni basin were obtained mostly from Wolfe (1989); data for the Zuni basin and the southern flank of the San Juan basin were derived from the work of Hook and others (1983) and Molenaar (1983); data for the subsurface of the San Juan basin were supplied by Molenaar and Baird (1992); and data for the panhandle of Oklahoma and northeasternmost New Mexico area were obtained partly from a publication by Holbrook (1992). Stratigraphic nomenclature proposed for the area of Pagosa Springs by Leckie and others (1997), the Montezuma Valley and Cortez Members of the Mancos Shale, is used here and noted on Sheet 1. Correlations from Pagosa Springs through the Raton basin are mostly the interpretations of Molenaar.

The distance along Transect D-D" is about 615 mi (990 km). The distance between the ends of the cross section, along an east-northeast-trending straight line, is about 450 mi (720 km). On cross sections D-D' and D'-D" (sheets 1 and 2), the horizontal scale is about 1 inch = 7.8 miles (1 centimeter = 4.9 kilometers) and the vertical scale is about 1 inch = 260 feet (1 centimeter = 31.2 meters). On chronostratigraphic cross section D-D" (Sheet 3), the horizontal scale is about 1 inch = 15.8 miles (1 centimeter = 10 kilometers) and the vertical scale is about 1 inch = 1.6 million years (1 centimeter = 0.63 million years).

The Cretaceous rocks of Transect D-D" are shown on the lithostratigraphic and chronostratigraphic cross sections as formations, members, tongues, lentils, and beds. Rock types of continental origin were not differentiated on the cross sections by the late senior author, probably because the contrasting strata were too thin to be depicted at the scale of the cross sections. Rocks of marine origin are classified as sandstone, shale and siltstone, and carbonate rock; these lithologic units commonly include lesser amounts of other rock types. The strata of this transect were described at more than 21 outcrops and from 14 boreholes. At many localities along the transect, outcropping marine beds yielded molluscan fossils, mainly ammonites and inoceramids, that were compared to the Cretaceous Western Interior ammonite zones (Cobban and others, 1994) to determine relative ages of the strata. Radiometric ages of Cretaceous bentonites in the Western Interior (Obradovich, 1993) have been used to establish precise ages for many of the fossil-zones.

The Cretaceous strata along Transect D-D" unconformably overlie formations of Permian, Triassic, and Jurassic ages. Near the western end of the transect in the San Juan Basin, Upper Cretaceous strata are unconformably overlain by rocks of Tertiary age. Nearby in eastern Arizona and in western New Mexico, Cretaceous siliciclastic rocks of continental and nearshore-marine origins are common. Most of these strata in the San Juan Basin, between the top of the Cenomanian Dakota Sandstone and the top of the Campanian Pictured Cliffs Sandstone, are about 5,000 ft (1,500 m) thick. Strata of approximately the same age near the eastern end of the transect, in the Raton Basin of northeastern New Mexico and in western Oklahoma, are composed mostly of siliciclastic and carbonate rocks that were deposited in offshore-marine environments. They are conformably overlain by Tertiary beds. Cretaceous strata in this area, from the top of the Cenomanian Dakota Sandstone to the top of the Maastrichtian Trinidad Sandstone, are about 3,500 ft (1,050 m) thick.

These cross sections were initially digitized and printed with the guidance of W.S. Larson, L.R. Bader, and M.E. Henry of the U.S. Geological Survey, whose selfless contributions to the preparation of these illustrations are much appreciated. Reviews of this report by T.S. Dyman, J.E. Fassett, J.L. Ridgley, D.J. Nichols, and K.L Varnes provided refinements to the stratigraphy, text, and drafting that are gratefully acknowledged. The following list of references for the stratigraphy of Cretaceous rocks in the region of Transect D-D" is not comprehensive. It includes citations only for those publications apparently used by Molenaar in constructing the cross sections and cited in this text. The cross sections, originally prepared by Molenaar, were revised and supplemented by Merewether after Molenaar's death.

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