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for

Sevier Orogenesis and Nonmarine Basin Filling: Implications of New Stratigraphic

Correlations of Lower Cretaceous Strata throughout Wyoming, U.S.A.

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PALYNOLOGICAL AGE DETERMINATIONS

Palynological analyses were conducted on mudstones for age determination and paleoenvironmental interpretations. All palynological analyses were performed by Dr. Donald W. Engelhardt (now deceased) at the Earth Sciences and Resources Institute, University of South Carolina, Columbia. Below is a summary of the methods that he used followed by his age determinations. The text in quotes in the age determination section is from a report that he submitted in 1999 to the basin analysis group at Indiana University headed by L.J. Suttner and L.C. Furer. Dr. Engelhardt did not know the location or stratigraphic position of the samples other than they were from Wyoming and of either Jurassic or Cretaceous age.

Mudstone samples were processed using the standard palynological maceration technique, as follows. Samples were treated with HCl to dissolve any carbonate minerals present, followed by treatment with HF to dissolve the silicate fraction. The samples were then subjected to differential flotation with ZnCl₂ (specific gravity of 2.0) to recover any organic material that was released from the sediment. The recovered organic material was treated with HNO₃ and KOH to release any palynomorphs from the organic residue. The organic material was screened with 90-, 44-, and 20-micron sieves to separate the various size fractions which were then mounted on

microscope slides using Clearcol and Elvacite.

Age determinations were based on comparison of the recovered palynomorph floras to published literature on the Late Jurassic and Early Cretaceous, unpublished petroleum company information, and previous studies on samples from Wyoming. No specific counts of individual taxa were made, however, the relative abundances of taxa in each sample were noted.

Bighorn Basin

SR16 - East

NW1/4, NE1/4, Section 22, T47N, R89W. The outcrop is located approximately 2.5 road miles west of Ten Sleep, on the south side of SR16.

Sample MZ-08. The sample was collected from a black shale a few decimeters below an A-interval sandstone. “The age of the sample is interpreted as Neocomian, possibly as old as Hauterivian but it could be younger. The sample contained *Trilobosporites canadensis*, *Cibotiumspora juncta*, *Cicatricosisporites* cf. *C. ludbrooki*, *Coronatospora valdensis* and *Plicatella crickmayi*. *Alisporites* spp. were common in the sample along with a few *Cedripites canadensis*. *Schizosporus reticulata* and *Schizophacus spriggii* were present with common *Botryococcus*. The organic material contained abundant dark brown to black angular and subrounded woody plant fragments. The paleoenvironment is interpreted as a lacustrine pond or lake on an alluvial plain.”

Sample MZ-12. The sample was collected from a mudstone approximately 3 m below the same A-interval sandstone as MZ-08. “The only possible age determination for this sample is Lower Cretaceous because of the paucity of age diagnostic palynomorphs in the sample. Rare *Schizosporus reticulata* were noted along with abundant *Botryococcus* colonies. The organic

material recovered consists mainly of abundant angular to sub-rounded woody plant fragments with rare biodegraded cuticular and cortical plant material. The paleoenvironment is interpreted as lacustrine.”

Nowood River

SW1/4, Section 33, T48N, R89W. The outcrop is on the west bank of the Nowood River.

Sample MZ-14. The sample was collected approximately 0.6 m below an A-interval sandstone.

“The sample is interpreted as Late Jurassic based on the presence of several specimens of

Callialasporites trilobatus, *C. turbatus*, *C. crenulatus*, *C. damperii*, *Cerebropollis mesozoicus* and many bivesiculate gymnosperm taxa. Many of these taxa are also found in the Lower Cretaceous.

The sample contained abundant pollen and spore taxa with poor to fair preservation. No definitive Early Cretaceous taxa were identified. This sample is an enigma to me. The organic material consists of biodegraded cuticular and cortical plant material with some dark brown to black woody material. *Schizophacus cf. spriggii* was frequently encountered but no *Botryococcus* was observed.

“The paleoenvironment is interpreted as an alluvial swamp deposit. This sample has many of the taxa...from the Brushy Basin Member of the Morrison Formation in Utah.”

Sample MZ-22. The sample was collected from a carbonaceous mudstone channel fill associated with the same A-interval sandstone as sample MZ-14. “The age of this sample is interpreted to be Neocomian probably Hauterivian/Barremian based on the presence of *Contignisporites cooksonii*, *Concavissimisporites informis*, *C. robustus*, *C. punctatus*, *Cicatricosisporites ludbrooki?*, *C. imbricatus*, *Trilobosporites canadensis*, *T. aequiverrucosus* and *Foraminosporis wonthaggiensis*. Several specimens of *Schizosporis reticulatus* and *Schizophacus spriggii* along with a few

colonies of *Botryococcus* were also present. The organic material consisted of abundant angular woody plant fragments with some cuticular and cortical material present. The paleoenvironment is interpreted as an alluvial swamp deposit. The palynomorph assemblage is similar to that described by Burden (1984) [from] the lower part of the Mannville Group (Lower Cretaceous) in Alberta and Montana. Several of the taxa are also reported by Burden from the Cloverly Formation at Alcova Reservoir (DeCelles and Burden, 1992).”

Sample MZ-13. The sample was collected 30 cm below MZ-22 from the same A-interval mudstone channel fill. “The age of the sample is questionably Early Albian. It could be as old as Neocomian (Berremian) but it does contain a few single specimens of *Equisetosporites* cf. *E. patapscoensis* and *Rugubivesiculites reductus*.” Because MZ-22 returned a Neocomian age and MZ-13 (this sample) was collected below MZ-22, the age of MZ-13 is interpreted as Neocomian. “The pollen flora was dominated by gymnosperms bivesiculate taxa. These include *Alisporites bilateralis*, *Cedripites canadensis*, *Podocarpidites granulatus*, *Pityosporites constrictus* and *Pristinuspollenites inchoatus*. No angiosperm pollen grains were noted in the sample. A few specimens of *Schizosporus reticulatus* were present along with rare *Botryococcus*. The organic material contained abundant dark brown to black, angular woody plant fragments with a few biodegraded cuticles present. The paleoenvironment is interpreted as an alluvial swamp deposit.”

Daryl's Ranch

E1/2, NW1/4, Section 34, T47N, R88W. The outcrop is located approximately 3 miles south-southeast of Ten Sleep, 0.25 - 0.5 miles west of the Nowood River.

Sample MZ-10. The sample was collected a few decimeters below an A-interval sandstone. “The only possible age determination is Lower Cretaceous because of the paucity of

palynomorphs in the sample. Rare specimens of *Schizosporus reticulata* and *Botryococcus* were observed. The organic material recovered consists of abundant biodegraded plant cuticles and cortical material with rare woody fragments present. The paleoenvironment is interpreted as lacustrine.”

Black Hills

Inyan Kara-9

SE, NW, SW, Section 13, T50N, R65W. Outcrop is a road cut on the north side of Interstate 90.

Sample MZ-02. The sample was collected from a mudstone laterally adjacent to an L2 sandstone. “The age of the sample was determined to be Middle Albian based on the presence of *Pilosiporites verus* which has a ‘top’ in Middle Albian age sediments, several specimens of *Fraxinoipollenites venustus*, *Retitricolpites maximus*, *Rousea prosimilis*, and *Tricolpites vulgaris*. Large bisaccate gymnosperm pollen was common to abundant along with *Pristinuspollenites inchoatus*. A few specimens of *Schizosporis reticulatus* and *Schizophacus parvus* were noted. The sample contained common pollen and spores with fair to good preservation, some biodegraded cuticles and cortical plant material, common resinite and abundant dark brown to black woody plant fragments. The paleoenvironment is interpreted as an alluvial swamp deposit.”

Sample MZ-03. The sample was collected from a mudstone laterally adjacent to an L3 sandstone that overlies the L2 sandstone associated with sample MZ-02. “The age of the sample is interpreted as questionably Middle Albian. Rare specimens of *Tricolpites vulgaris* were observed along with questionable *Triporoletes radiatus*. *Schizosporus reticulata* was common along with

rare *Botryococcus*. Palynomorph recovery and preservation was poor in the sample. The organic material was dominated by dark brown to black angular woody plant material and some resinite similar to that observed in sample MZ-02. The paleoenvironment is interpreted as an alluvial swamp deposit.”

Sample MZ-04. The sample was collected from a mudstone within the basal Fall River Formation. “The age of the sample is interpreted as questionably Middle Albian. Rare specimens of *Tricolpites vulgaris* were observed along with *Ceratosporites equalis*. *Schizosporus reticulata* is present along with rare *Botryococcus*. Palynomorph recovery and preservation was poor. The organic material was dominated by dark brown to black angular woody plant fragments, rare plant cuticles and some resinite similar to that observed in samples MZ-02 and MZ-03. In addition, some reworked, dark brown palynomorphs with pyrite holes in them were noted. These could be Jurassic or older in age. The paleoenvironment is interpreted as a fluvial swamp deposit.”

REFERENCES CITED

- Burden, E.T., 1984, Terrestrial palynomorph biostratigraphy of the lower part of the Mannville Group (Lower Cretaceous), Alberta and Montana, *in* Stott, D.F., and Glass, D.J., eds., The Mesozoic of middle North America: Canadian Society of Petroleum Geologists, Memoir 9, p. 249-269.
- DeCelles, P.G., and Burden, E.T., 1992, Non-marine sedimentation in the overfilled part of the Jurassic-Cretaceous Cordilleran foreland basin: Morrison and Cloverly Formations, central Wyoming, USA: Basin Research, v. 4, p. 291-313.