

DATA REPOSITORY ~~APPENDIX~~ TEXT

**Sr isotope evidence for a lacustrine origin for the upper Miocene to Pliocene Bouse Formation,
lower Colorado River trough, and implications for timing of Colorado Plateau uplift**

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SAMPLE LOCATIONS AND DESCRIPTIONS

Cibola area (Cibola, Ariz. 15' Quadrangle)

95BS-3. A sample of loosely cemented barnacle shell hash from near the top of the Cibola carbonate sequence that yielded abundant barnacles without adhering carbonate cement. Sample from northwestern edge of small mesa, from mesa-capping unit of calcarenitic limestone and shell debris. Cleaned barnacle fragments were analyzed. 410 ft. elev.; 33° 15.41' N. lat., 114° 38.47 W. lon.

95BS-9. A sample of carbonate-cemented gravel including rounded oolitic(?) grains and shell debris that forms part of a 1-m-thick, cross-bedded unit in the middle of the carbonate sequence exposed on a cliff shown by

Metzger (1968, Figure 3). In thin section this sample appears as 40-50% rounded, pellet-like grains and irregular grains, both of very fine grained calcite, 20% matrix of very fine grained calcite, 10% shell fragments, 10-25% sparry calcite, and 5-15% non-calcareous sand grains. Rounded calcareous grains have weak to moderately well developed concentric form with both sparry and micritic layers (oolitic grains). Irregular grains and shell fragments commonly have carbonate coating. Concentric layering and uniform coating suggest that carbonate precipitation on these grains occurred before deposition; 370 ft. elev.; 33° 15.48' N. lat., 114° 38.51 W. lon.

95BS-12. Marl from 3 cm above the sharp base of the calcareous lower Bouse Formation that drapes over locally derived, pre-Bouse gravels. Lack of carbonate cement or veins in these underlying gravels suggest little or no post-depositional movement and precipitation of carbonate. In thin section this sample appeared as 1-3 micron calcite crystals and 10-100 micron sand grains, with no sparry calcite. Sample from north flank of unnamed wash, base of Bouse Formation; 320 ft. elev.; 33° 15.78' N. lat., 114° 38.47 W. lon.

96BS-1. Marl with abundant nodular silica from 20 cm above location of sample 95 BS 3; 410 ft. elev.; 33° 15.41' N. lat., 114° 38.47 W. lon.

96BS-3. Pebble with sparry calcite coating from same bed as 95BS-9; 370 ft. elev.; 33° 15.48' N. lat., 114° 38.51 W. lon.

96BS-13. Caliche (carbonate coating) from cobble within fan gravels overlying Bouse Formation; 430 ft. elev.; 33° 16.99' N. lat., 114° 37.78 W. lon.

Palo Verde Mountains

96BS-5. Massive tufa directly overlying Tertiary volcanic rocks; 320 ft. elev.; 33° 19.28' N. lat., 114° 44.06 W. lon.

96BS-6. Veinlets hosted by Tertiary volcanic rocks from 1-2 m below 30° dipping basal contact of tufa.

Volcanics are homogeneous, massive, plagioclase-rich intermediate to mafic volcanics probably correlative with Quechan volcanics to south; 320 ft. elev.; 33° 19.28' N. lat., 114° 44.06 W. lon.

Milpitas Wash

95BS-16. A sample of a very fine grained, dull white, 10 cm porcellanous marl bed. The sampled bed is the highest resistant carbonate bed at the top of a zone of interbedding between silty carbonate and overlying friable calcareous siltstone. In thin section this sample appears as 1-10 micron, mottled calcite and brown opaque clay(?) with 2-3% quartz, feldspar, and lithic rock fragments up to 40 microns diameter. No sparry calcite was seen. West flank of mouth of minor wash that enters Milpitas Wash from south; 280 ft. elev.; 33° 15.60' N. lat., 114° 43.75 W. lon.

95BS-17. Sample of uncemented barnacle shell hash in a soft calcareous and silty matrix about 3 m stratigraphically below sample 95BS-16. Co-existing bivalves are all empty casts, whereas the barnacles are all preserved. Cleaned barnacle fragments were analyzed. Cutbank on east flank of minor wash upstream from 95BS-16; 290 ft. elev.; 33° 15.54' N. lat., 114° 43.73 W. lon.

Buzzards Peak area, Chocolate Mountains

96BS-9. Caliche cement coating cobble of rhyolite (quartz, sanidine bearing volcanic); 1120 ft. elev.; 33° 9.55' N. lat., 114° 56.74' W. lon.

96BS-10. Chalky (tuffaceous?) tufa; 1040 ft. elev.; 33° 9.72' N. lat., 114° 56.98' W. lon.

96BS-11. Limestone with *Chara* impressions from 30 m south of 96BS-11; 1000 ft elev.; 33° 9.83' N. lat., 114° 57.01' W. lon.

Blythe area subsurface

LCRP-27: Drill hole sample from 516'-524' depth in well LCRP 27 (see Metzger and others, 1973 for well log).

Gastropod analyzed for $^{87}\text{Sr}/^{86}\text{Sr}$ is genus *Pyrgulopsis*. Bob Hershler of the Smithsonian Institution, in a letter to Andy Cohen (University of Arizona) dated 22 May, 1996, writes that, for identical shells from 599'-602' depth, "The shells are obviously hydrobiid and would appear to belong to the genus *Pyrgulopsis*, which at least in Recent times is strictly inland, freshwater. The shells may conform to those from the Muddy Creek Formation that Taylor (Univ. Mich., Contrib. Mus. Paleo. 26, 1983) referred to "*Fluminicola*" *avernalis* (= *Pyrgulopsis avernalis*), a species which today lives in springs in Moapa Valley (SE Nevada)." The top of the 24' thick marl at the base of the Bouse Formation is at a depth of 857'. Clay, silt, and sand make up the rest of the Bouse Formation over the well depth interval 118'-857' (Metzger and others, 1973). Elevation of well head is ≈ 300 ft.; elevation of analyzed sample is ≈ 220 ft. below sea level; elevation of sample identified by Hershler is ≈ 300 ft. below sea level; $33^{\circ} 54.68'$ N. lat., $114^{\circ} 28.14'$ W. lon.

Osborne Wash

96BS-15. Sample from base of marl layer; 600 ft. elev.; $34^{\circ} 8.64'$ N. lat., $114^{\circ} 11.67'$ W. lon.

96BS-16. Sample of caliche (carbonate coating on clast) from old alluvial fan surface 10 m above Bouse Formation; 640 ft. elev.; $34^{\circ} 8.62'$ N. lat., $114^{\circ} 11.57'$ W. lon.

Earp area, north of Parker

96BS-18. Sample of 120-130 cm thick marl bed that forms local base of Bouse Formation. Sample from 10 cm above base; 400 ft. elev.; $34^{\circ} 9.82'$ N. lat., $114^{\circ} 18.01'$ W. lon.

Topock area

96BS-21. Samples of basal Bouse marl from approx 400 m NE of turnout on north side of side of Interstate 40.

Sample 21 is of crumbly, platy material at top of marl bed; 580 ft. elev.; $34^{\circ} 43.17'$ N. lat., $114^{\circ} 31.32'$ W. lon.

Silver Creek Wash, Black Mountains

96BS-23. Tufa from 6-8 m (vertical) above Silver Creek Wash, north side of wash, at downstream side of bedrock hill. Tufa mantles bedrock hill for 50-100 m to north, is 2-3 m thick, and is somewhat discontinuous although it is not known if discontinuous character is primary or secondary; 1700 ft. elev.; $35^{\circ} 5.33'$ N. lat., $114^{\circ} 28.54'$ W. lon.

96BS-25. Sample of marl from 130-140 cm above base of 2 m thick, thin bedded marl; 1760 ft. elev.; $35^{\circ} 5.23'$ N. lat., $114^{\circ} 28.13'$ W. lon.

Hualapai Limestone, Lake Mead area

HU 2. Somewhat resistant limestone with worm(?) tubes, 2120 ft. elev.; $35^{\circ} 58.48'$ N. lat., $114^{\circ} 24.84'$ W. lon.

HU 5. Friable marl from 1-2 m below ridge crest west of road 143; 2100 ± 50 ft. elev.; $35^{\circ} 58.49'$ N. lat., $114^{\circ} 20.73'$ W. lon.

Imperial Formation (Arroyo Tapiado 7 1/2' Quadrangle)

95I-23. A bivalve shell, *Anomia* sp., from just above the base of the tidal flat facies of Kerr and Kidwell (1991; Camels Head Member of Winker, 1987). Strata of the tidal flat facies are similar to the underlying delta front facies but are commonly more red or orange, which reflects more oxidizing conditions. This sample was collected from mudstone about 150 m stratigraphically above sample 95I-28. This sample had small adhering detrital particles, apparently by cementation, to the outside of the valve. Sample from north flank of Fish Creek Wash, 32° 58.57' N. lat., 116° 9.26' W lon.

95I-28. An oyster shell, *Dendostrea* sp., from a sandy coquina bed within the stratigraphic center of massive claystone, mudstone, and siltstone that make up the delta front facies of Kerr and Kidwell (1991; Deguynos Member of Winker, 1987). Shells were unaffected by cementation and most were unbroken. Sample from north flank of Loop Wash northwest of confluence of Loop Wash and Fish Creek Wash, 32° 58.91' N. lat., 116° 9.05' W lon.

Yuma area subsurface: Two samples, each consisting of a grayish white mollusk fragment from Exxon Yuma-Federal No. 1 Well (Arizona Geological Survey well #ABM 3316). Shell fragments were not coated with secondary calcite but contained small indentations where sand grains were squeezed into the shell and some shell material was lost due to pressure solution. Sample is from San Luis basin of Winker and Kidwell (1976). Sampled depth in within depth interval (3162' - 5337') correlated with Bouse Formation by Eberly and Stanley (1978). Well head at ≈150 ft. elev.; 32° 29.42' N. lat., 114° 44.40' W lon.

Sample 3316/3260'. Mollusk fragment from 3260' well depth.

Sample 3316/3400'. Mollusk fragment from 3400' well depth.