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Conodont-based Revision of Upper Devonian–Lower Pennsylvanian Stratigraphy in the Lake Mead Region of Northwestern Arizona and Southeastern Nevada

SCOTT M. RITTER
School of Geology, Oklahoma State University, Stillwater, OK 74078

Thesis Chair: MORRIS S. PETERSEN

ABSTRACT

Historically, Devonian through lowest Pennsylvanian rocks at Iceberg Ridge, located on Lake Mead, northwestern Arizona, have been assigned to the Temple Butte, Redwall, and Watahomigi Formations. Sparse conodont recoveries from these rocks permit recognition of two conodont zones and allow refinement of lithostratigraphic and chronostratigraphic boundaries at Iceberg Ridge. Conodont species characteristic of the upper Famennian Lower *expansa* Zone (*Polygnathus subirregularis, P. experplexus, P. perplexus, P. semicostatus, P. communis communis, Icriodus costatus, I. raymondi, Clydagnathus ormistoni, Pelekysgnathus inclinatus* and *Scaphignathus* sp.) occur in limestones previously assigned to the base of the Redwall Limestone. Twenty-six meters of limestone are herein reassigned to the upper Devonian Crystal Pass Member of the Sultan Limestone. The Osagean *typicus* Zone extends from 30 m to 63 m above the base of the emended Redwall Limestone and is bounded both above and below by barren intervals. Diagnostic species recovered at Iceberg Ridge include *Gnathodus typicus* M1, *G. delicatus, Pseudopolygnathus multistriatus* M2, *P. nudus* M1, *P. oxypageus* M2, *Polygnathus communis communis*, and *Bispathodus stabilis.* Morrowan age conodonts including *Declinognathodus noduliferus, Rhachistognathus muricatus, R. minutus declinatus, Adetognathus spathus, A. lautus*, and *Idiognathodus* spp. appear 30 m above the base of the Watahomigi Formation.

INTRODUCTION

Paleozoic rocks on Iceberg Ridge, located in the upper Lake Mead region of northwestern Arizona and southeastern Nevada, comprise over 2100 m of Cambrian, Devonian, Mississippian, Pennsylvanian, and Permian strata. The stratigraphy of this area, which is situated in the transition zone between the southern Colorado Plateau (Grand Canyon) and the Basin and Range physiographic provinces, has been the subject of several studies dating back to the early part of this century (Beus 1979, Darton 1910, Longwell 1921, McKee and Gutschick 1969, Matthews 1976). Because most rocks are unfossiliferous, particularly in the lower part of the section, the placement of system boundaries has relied upon lithostratigraphic correlation from the Grand Canyon to the east or from the Muddy Mountains to the west. Due to rapid east-to-west changes in both facies and overall thickness, these boundary placements have often been tentative. Recovery of conodont faunas from Devonian through Pennsylvanian rocks at Iceberg Ridge, Arizona (fig. 1), permits recognition of two conodont zones and forms the basis for a revision of Devonian through lowest Pennsylvanian chronostratigraphy and lithostratigraphy at this locality.

STRATIGRAPHY

INTRODUCTION

Cambrian and Devonian through Pennsylvanian rocks are well exposed on the west face of Iceberg Ridge and have been the subject of studies by Beus (1979), McKee and Gutschick (1969), and Matthews (1976). These workers assigned Devonian, Mississippian, and lower Pennsylvanian strata to the Temple Butte, Redwall, and Callville Formations, respectively. Later, in his monograph on the Supai Group of Arizona, McKee (1981) reassigned

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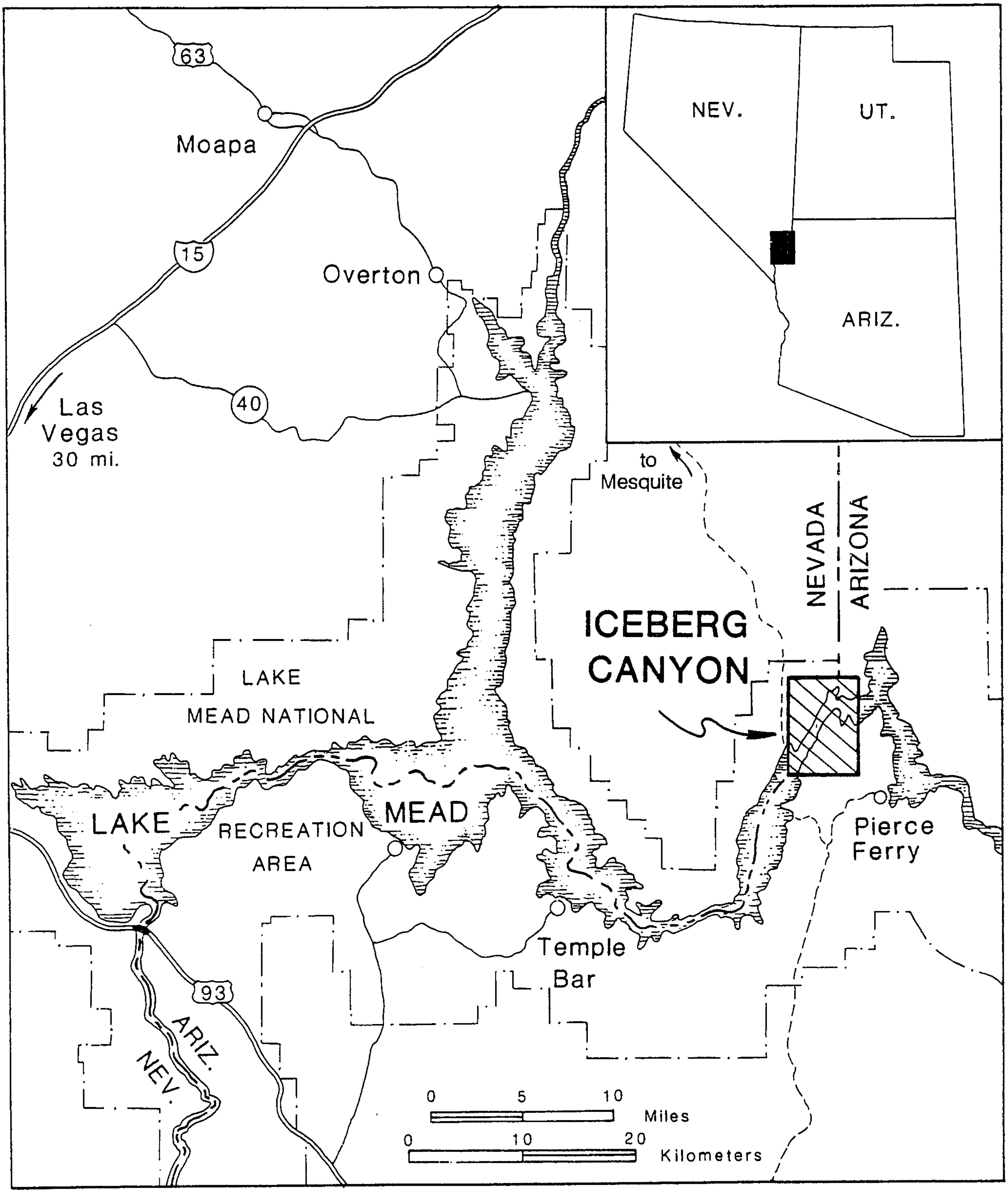


FIGURE 1.—*Index map showing location of Iceberg Canyon on the upper part of Lake Mead, Nevada-Arizona. Iceberg Ridge forms the east (Arizona) wall of Iceberg Canyon (T. 32 N, R. 17 W).*

the Lower Pennsylvanian strata to the Watahomigi Formation. Each of these formations is recognized in this study. In addition, conodont data indicate that the lower 26 m of the Redwall as described by these previous authors is upper Devonian in age and should be reassigned to the Crystal Pass Member of the Sultan Limestone. Devonian through Lower Pennsylvanian rocks on Iceberg Ridge described herein comprise the Temple Butte Formation, Crystal Pass Member of the Sultan Limestone, emended Redwall Limestone, and Watahomigi Formation (figs. 2 and 3).

DEVONIAN SYSTEM

Temple Butte Formation

Although the name Temple Butte was originally applied to thin, discontinuous limestones in the eastern Grand Canyon by Walcott (1890), the name has been extended to Devonian rocks over the entire Grand Canyon region including Iceberg Ridge by Beus (1969, 1979, 1980), McKee (1969), and Matthews (1976). At Iceberg Ridge the Temple Butte consists of medium to olive gray, thin- to thick-bedded crystalline dolostones with a few thin breccias and sandstones in the upper part. The sequence forms a series of ledgy slopes that underly the prominent cliffs of the Redwall Limestone. The exact thickness of the Temple Butte in the upper Lake Mead area is unknown. Beus (1969) and McKee (in Poole and others 1967) reported over 400 m of Devonian dolostones resting unconformably upon Cambrian dolostones designated as undifferentiated Cambrian. More recently, Matthews (1976) placed the Cambrian-Devonian boundary much higher in the section, giving a total Temple Butte thickness of only 143 m. Matthews placed the Cambrian-Devonian boundary at a transition from light-colored, weakly fetid dolostones to dark gray, strongly fetid dolostones but cited no evidence in the form of fossils or unconformity surfaces to substantiate this placement. The position of the Cambrian-Devonian boundary is obscured by the paucity of both macrofossils and microfossils in the Temple Butte at Iceberg Ridge.

McKee (1969) indicated that the Temple Butte is approximately correlative with the Jerome Member of the Martin Formation of central Arizona. This lithostratigraphic correlation suggests that the Temple Butte is Frasnian in age. This age assignment was substantiated by the report of possible latest Givetian to late Frasnian conodonts in the Temple Butte Formation of the central Grand Canyon (Beus 1980, p. 62).

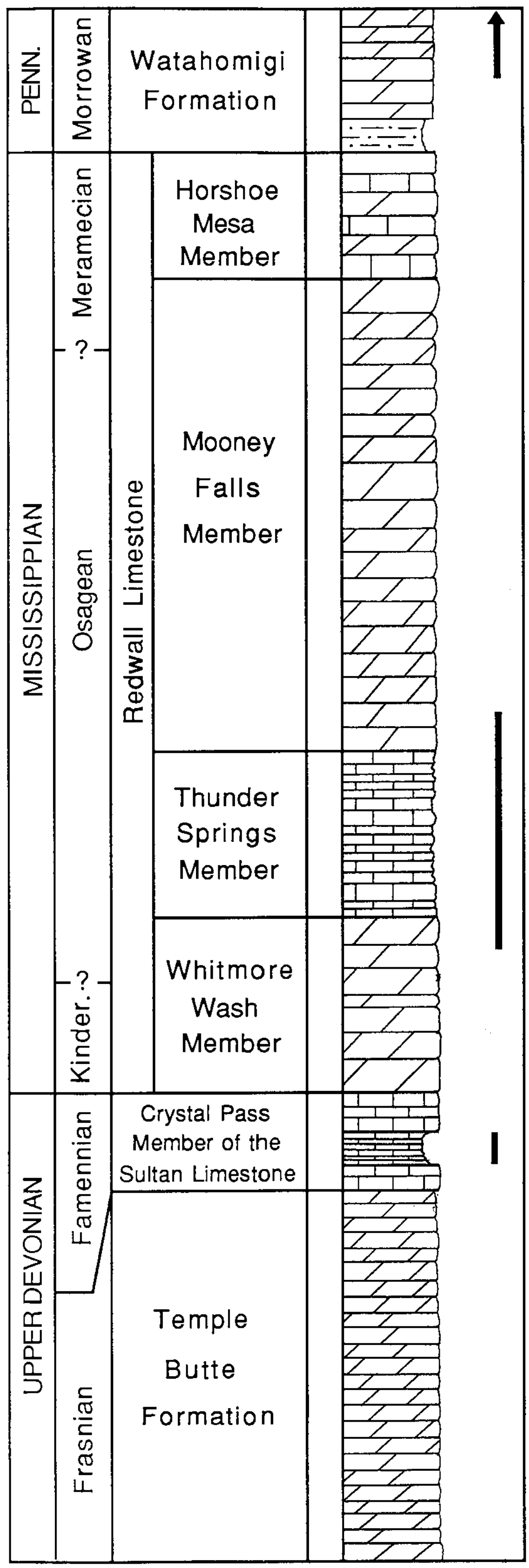


FIGURE 2.—*Stratigraphic column of Devonian through lowest Pennyslvanian strata on Iceberg Ridge. Vertical lines to the right of the column indicate conodont-bearing intervals.*

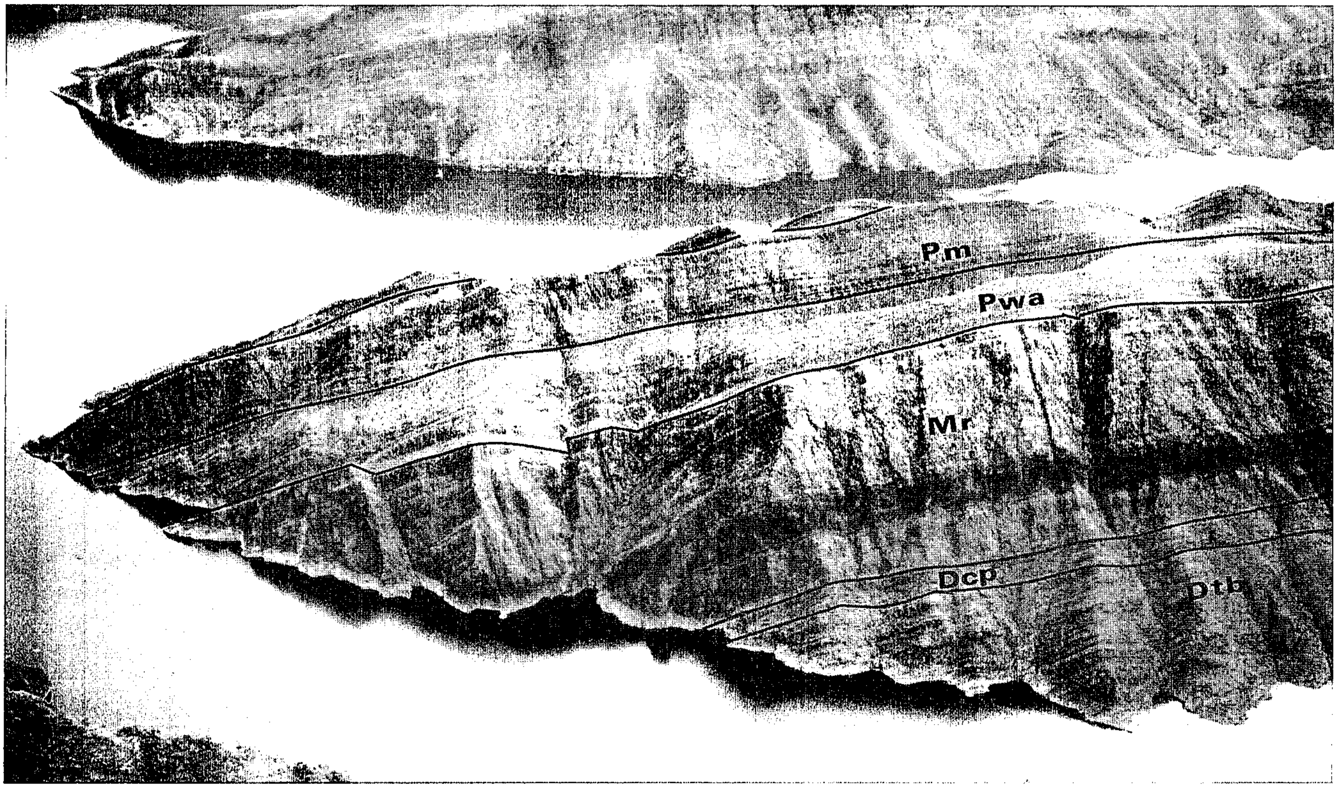


FIGURE 3.—*Oblique aerial photo of the west face of Iceberg Ridge showing the redefined formation and system boundaries. Dtb-Temple Butte Formation; Dcp-Crystal Pass Member of the Sultan Limestone; Mr-Redwall Limestone; Pwa-Watahomigi Formation; Pm-Manakacha Formation. (Photo courtesy of Stan Beus.)*

Crystal Pass Member, Sultan Limestone

The Crystal Pass Member of the Sultan Limestone was first described by Hewett (1931) for exposures of light bluish gray, unfossiliferous, porcelainlike limestone just south of Goodsprings, Nevada. Although the Sultan Limestone as a whole was assigned to the Devonian System, the exact age of the Crystal Pass Member was not discussed. More recently, Langenheim and Collinson (1962) and Reinbold and Langenheim (1977) have assigned a Famennian age to the Crystal Pass in southern Nevada on the basis of conodont occurrences. Because of the similarities in lithology, stratigraphic position, and age (as indicated by conodonts), the 26 m of limestone previously assigned to the Redwall Limestone at Iceberg Ridge are herein reassigned to the Crystal Pass Member of the Sultan Limestone.

The Crystal Pass is easily recognizable on the west face of Iceberg Ridge where it forms a distinct light bluish gray band between the tan to medium gray dolostones of the underlying Temple Butte Formation and overlying Whitmore Wash Member of the Redwall Limestone.

Two sections of the Crystal Pass were measured: section A at the north end of Iceberg Ridge, and section B located 9 km to the south at South Cove (fig. 4). At section A the Crystal Pass is divided into five informal units (fig. 5). These units weather into a basal cliff (units 1–3), a middle recessive slope (unit 4), and an upper cliff (unit 5). Unit 1, which forms the bulk of the lower cliff, is 6 m thick and consists of light gray, unfossiliferous lime mudstone that grades upward into peloidal packstone with a fenestral fabric. A thin intraformational conglomerate occurs 4.5 m above the base. The upper few centimeters of the unit is a nodular limestone with an irregular upper surface. Unit 2 is a single 20-cm-thick bed of light gray intraclastic grainstone. Intraclasts are elongate and range from 1 to 10 cm in length. Unit 3 is also a single bed. This 50-cm-unit grades from a coarse limestone conglomerate at the base to lime mudstone in the upper half. The upper few centimeters is composed of nodular limestone with a shaly matrix. The fenestral fabric, lack of fossils, predominance of peloidal grainstones, and intraformational conglomerates are suggestive of shallow subtidal to peritidal conditions.

The upward transition to unit 4 is marked by notable changes in weathering profile, color, texture, and bedding. Unit 4 is 7.5 m thick and comprises thin bedded (10–20 cm) mudstones to wackestones. The limestones of

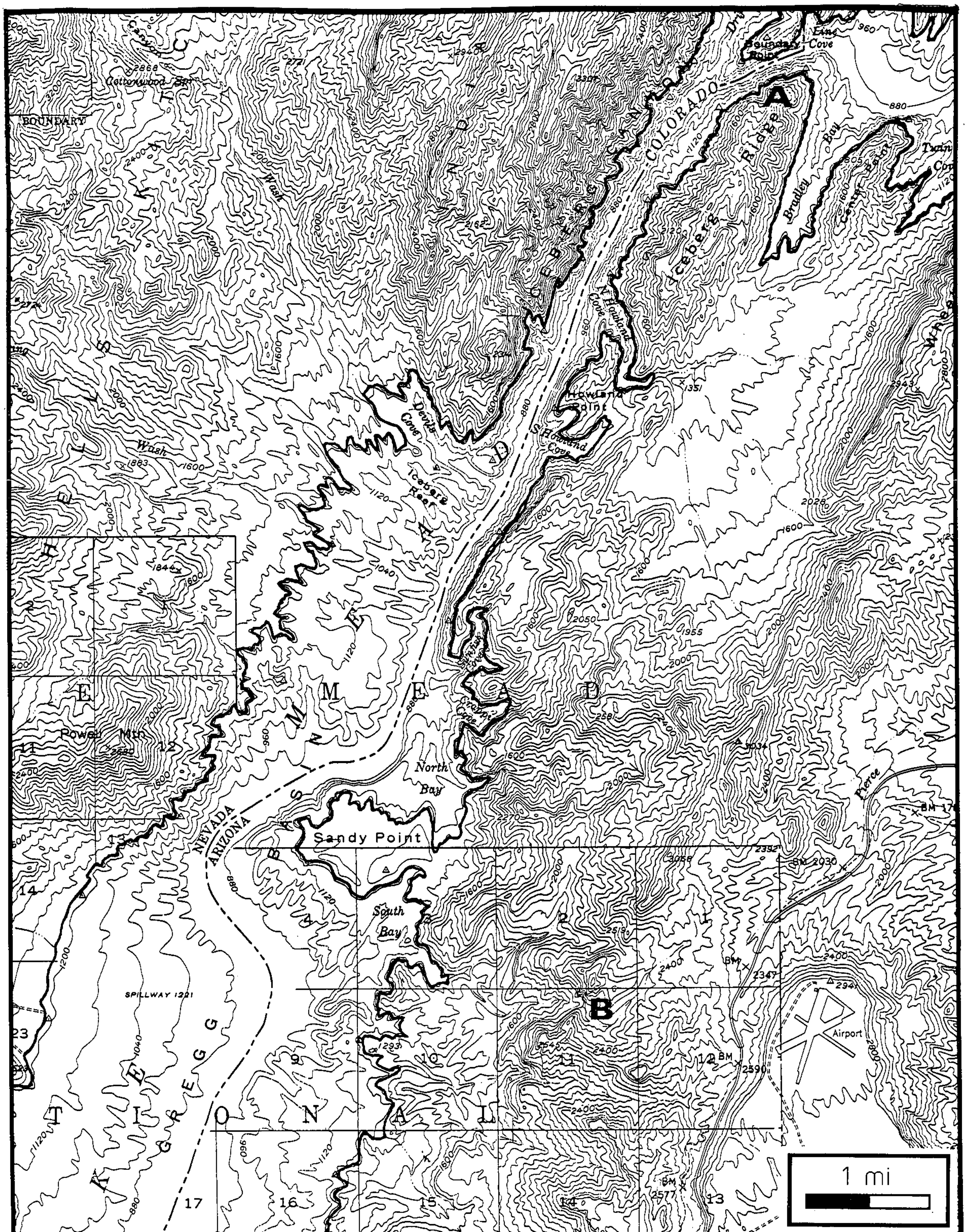


FIGURE 4.—*Map showing location of Crystal Pass sections A and B on the west shore of Lake Mead. Heavy black line indicates shoreline of Lake Mead. Map copied from Iceberg Canyon, Nevada 15-Minute Quadrangle.*

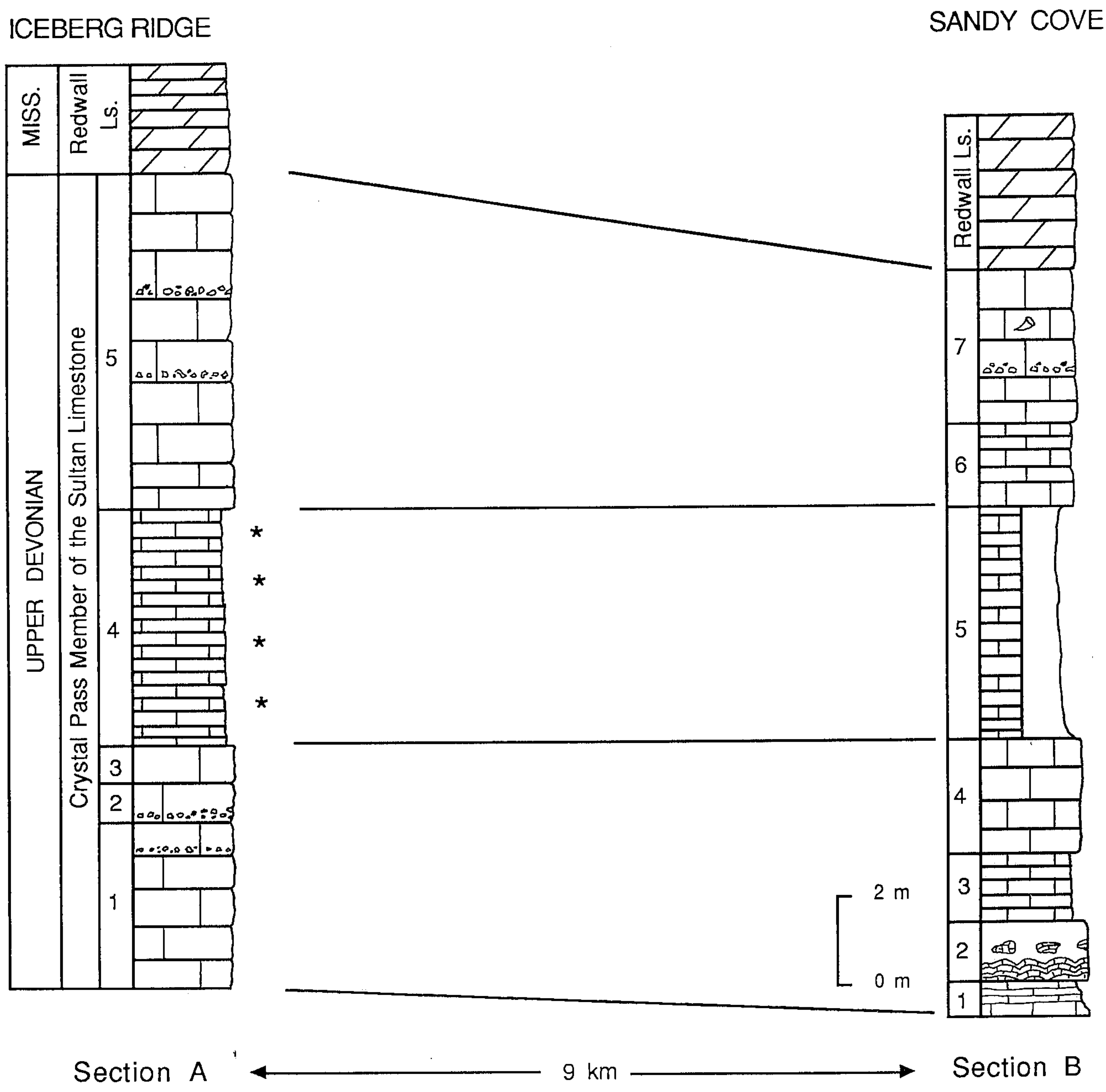


FIGURE 5.—*Correlation of the Crystal Pass Member of the Sultan Limestone between sections A and B.*

unit 4 are notably darker than the limestones of the underlying or overlying units. Along much of Iceberg Ridge this unit forms a partially covered recessive slope. In the upper 1 m the unit grades from evenly bedded limestones to burrowed, nodular limestones. Unbroken, articulated specimens of the brachiopod *Paurorhyncus cooperi* and fragments of fish bones (up to 10 cm long) are present in unit 4. This unit was deposited in deeper subtidal conditions than those represented by the underlying units.

The uppermost unit of the Crystal Pass at section A is made up of 11 m of medium- to thick-bedded light gray limestone that forms a prominent cliff along much of Iceberg Ridge. This unit is unfossiliferous and contains numerous intraformational conglomerates and reflects a return to shallower subtidal conditions.

Section B is located just east of Sandy Cove, approximately 9 km south of section A (fig. 4). At this locality the Crystal Pass weathers into a lower cliff, middle recessive slope, and upper cliff just as it does at section A (fig. 5).

The lithologies making up these weathering units differ, however, in some respects. At locality B the lowermost few meters of the section consist of thin peloidal grainstones overlain by stromatoporoid boundstones. The stomatoporoid coenostea are laminar and appear to be in growth position. The boundstones are succeeded upward by a 50-cm-thick stromatoporoid-clast intraformational conglomerate. At the Sandy Cove section the middle recessive unit is covered with regolith, and no lithologic comparison with section A is possible. The upper cliff-forming unit at Sandy Cove is only 7.5 m thick, compared to 11 m at Iceberg Ridge. This unit differs at Sandy Cove in bearing two coral-rich horizons (fig. 5) not found at Iceberg Ridge. These horizons are located 4.5 m and 6 m above the base of the unit and bear solitary and colonial and solitary corals, respectively. In both beds the corals are randomly oriented and moderately broken, suggesting postmortem transport.

The Crystal Pass at these localities represents deposition during a single transgressive-regressive cycle. The lower cliff-forming limestones were deposited in restricted peritidal to shallow subtidal settings during the transgressive phase of the cycle. The middle recessive unit, which is characterized by thinner bedding and normal marine fossils, represents the maximum flooding phase. The upper cliff-forming limestones were deposited during regression of the late Famennian ocean from this area.

MISSISSIPPIAN AND PENNSYLVANIAN SYSTEMS

Redwall Limestone

The Redwall Limestone is a conspicuous, cliff-forming rock unit in the walls of the Grand Canyon and adjacent areas of northern Arizona. Over most of its areal extent the Redwall can be divided into the Whitmore Wash, Thunder Springs, Mooney Falls, and Horseshoe Mesa Members (McKee 1963). These formal members are well exposed at Iceberg Ridge where they reach a composite thickness of 225 m.

The base of the Redwall, as emended herein, is marked by a sharp transition from light gray porcelaineous limestones of the Crystal Pass to tan, very coarsely crystalline dolostones of the Whitmore Wash Member of the Redwall. On the north end of Iceberg Ridge the Whitmore Wash consists of 40 m of light tan to pink, medium- to very thick-bedded, cliff-forming dolostone that is devoid of megafossils.

Overlying the Whitmore Wash dolostones are the interbedded cherts and fossiliferous limestones of the Thunder Springs Member. This member consists of thin beds (0.05 to 0.3 m) of medium gray lime mudstone to wackestone interbedded with irregular beds and elongate lenses (0.03 to 0.21 m) of chert. The Thunder Springs is 40 m thick and forms an obvious dark band in the Redwall cliff on Iceberg Ridge (fig. 3). This member is the only fossil-rich unit in the Redwall at this locality. Common macrofossils include brachiopods, crinoids, bryozoans, and gastropods.

The Mooney Falls is the thickest member of the Redwall at Iceberg Ridge, where it consists of 125 m of light to medium gray dolostone. The Mooney Falls dolostones are thick to massively bedded and commonly display coarsely crystalline textures. Fossils are present only in the lower few meters of the member with the exception of a silicified *Syringopora* horizon that occurs 96 m above the base of the Mooney Falls Member.

The base of the overlying Horseshoe Mesa Member is drawn at the first gray limestone above the monotonous dolostones of the Mooney Falls. Above this point bedding becomes thinner, and interbedded limestones and dolostones predominate.

Watahomigi Formation

McKee and Gutschick (1969) placed the upper boundary of the Horseshoe Mesa Member at the base of a 10-m-thick unit of reddish brown shaly siltstone (referred to hereafter as the "red siltstone") that forms an obvious recessive slope above the Redwall cliff (figs. 2 and 3). This siltstone was regarded as the basal unit of the Pennsylvanian Callville Limestone by these authors. Later, Beus (1979) assigned the "red siltstone" (which he designated field unit 9), along with approximately 40 m of overlying carbonates (units 10–15 of Beus 1979, fig. 18), to the upper part of the Horseshoe Mesa Member of the Redwall Limestone. More recently, McKee (1981) reassigned this slope-forming siltstone to the base of the Pennsylvanian Watahomigi Formation (Supai Group).

CONODONT BIOSTRATIGRAPHY AND SYSTEM BOUNDARIES

In an attempt to refine the lithostratigraphically based placement of system boundaries in the upper Lake Mead area, the Devonian through lowest Pennsylvanian succession of Iceberg Ridge was measured and sampled for conodonts. Initially, more than 260 1 kg samples were collected at 1.5 m intervals through the Temple Butte, Crystal Pass, Redwall, and lower Watahomigi strata at the northern end of Iceberg Ridge. This was followed by detailed sampling of the Crystal Pass Member at Iceberg Ridge (section A) and Sandy Cove (section B). This endeavor revealed that conodonts occur only sporadically within the section (fig. 2). Recoveries were sufficiently abundant, however, to permit recognition of two conodont zones and to allow refinement of the Devonian-Mississippian and mid-Carboniferous boundaries.

One hundred samples were collected from the Temple

Butte Formation on the west face of Iceberg Ridge in an attempt to confirm the Frasnian age of this unit at Iceberg Ridge and to perhaps resolve the conflicting placements of the Cambrian-Devonian boundary. No conodonts were recovered, and the age of the unit and placement of the system boundary remain problematical.

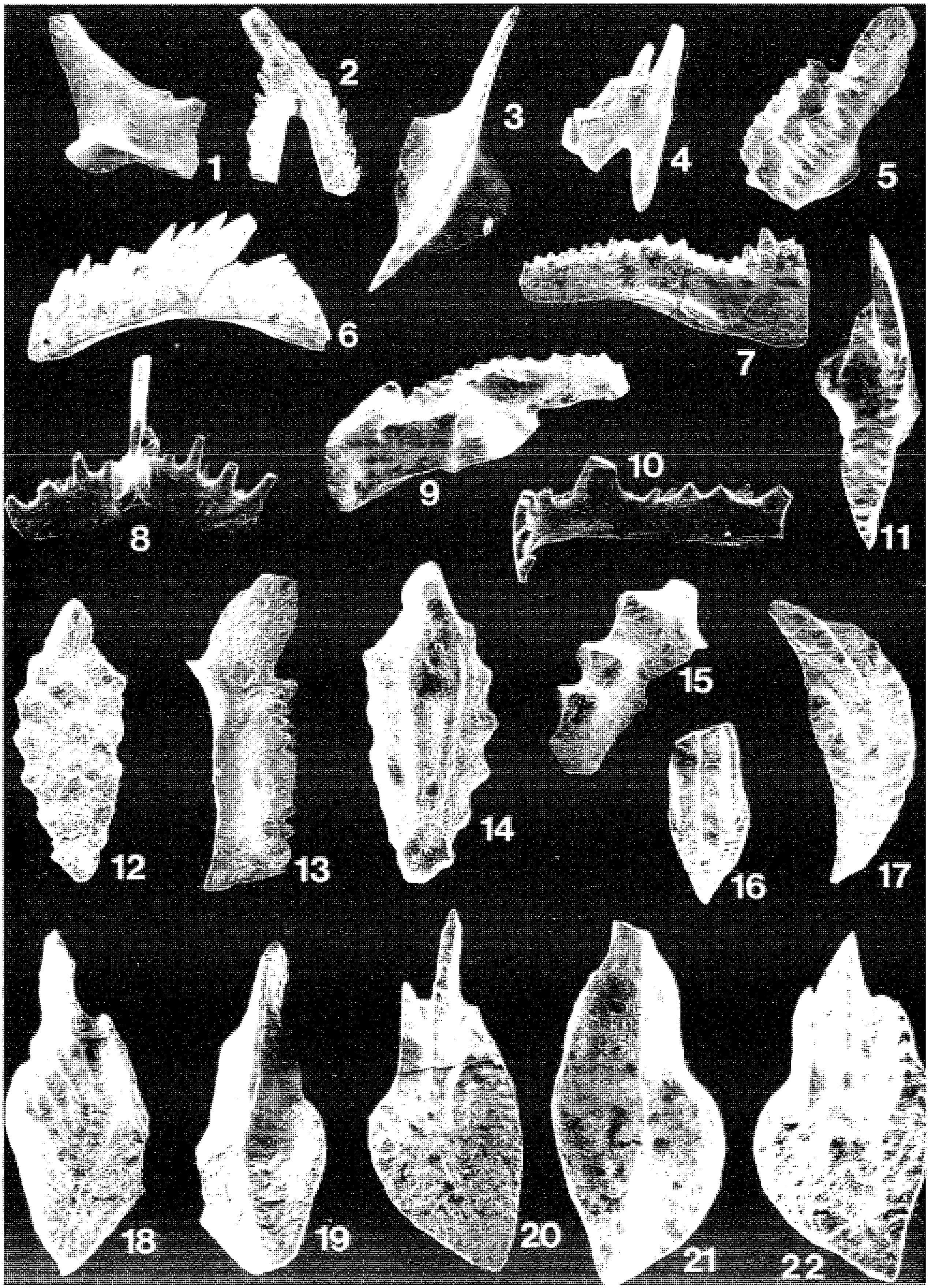
The oldest conodonts recovered in this study occur within the Crystal Pass Member of the Sultan Limestone. Within the Crystal Pass, conodonts are restricted to the fossil-bearing wackestones of unit 4. Faunas from unit 4 at section A are characterized by elements of *Polygnathus subirregularis, P. experplexus, P. perplexus, P. semicostatus, P. communis communis, Icriodus costatus, "Icriodus" raymondi, Clydagnathus ormistoni, Pelekysgnathus inclinatus,* and *Scaphignathus* sp. (plate 1). The co-occurrence of *Polygnathus experplexus* and *P. subirregularis* permits at least unit 4 to be assigned to the late Famennian Lower *expansa* Zone (fig. 6) of Ziegler and Sandberg (1984). The absence of fossils in unit 5 and in the base of the overlying Redwall Limestone precludes exact placement of the Devonian-Mississippian boundary. However, the boundary is tentatively placed (using sedimentological criteria) at the sharp contact between peloidal limestones of unit 5 (which represents the regressive hemicycle of the Crystal Pass Member at this locality) and the coarse, tan dolostones of the overlying Whitmore Wash Member of the Redwall Limestone.

Conodont-bearing horizons within the Redwall Limestone at Iceberg Ridge occur 25 and 30 m above the base of the Whitmore Wash Member, throughout the Thunder Springs Member, and in the lower few meters of the Mooney Falls Member (fig. 7). A dolostone bed located 25 m above the base of the Redwall Limestone produced a sparse conodont fauna characterized by Pa elements of *Pseudopolygnathus multistriatus* M2 and *Polygnathus communis communis* (plate 2). A second Whitmore Wash horizon located 5 m higher yielded moderately abundant specimens of *Pseudopolygnathus oxypageus* M2, *P. communis communis,* and *Bispathodus stabilis. Pseudopolygnathus nudus* M2 appears at the base of the Thunder Springs Member. Other species present at various horizons in the Thunder Springs include *P. oxypageus* M2, *Gnathodus delicatus, G. typicus* M1, *B. stabilis,* and *P. communis communis.* These latter two species range throughout the Thunder Springs and into the lower 18 m of the overlying Mooney Falls Member. Conodont species recovered from the Redwall permit assignment of the upper Whitmore Wash, Thunder Springs, and lower Mooney Falls to the early Osagean *Gnathodus typicus* Zone of Lane and others (1980). The first occurrence of *Pseudopolygnathus oxypageus* M2 30 m above the base of the Whitmore Wash permits subdivision of the *typicus* Zone into the Lower and Upper *typicus* Zones of Lane and others (1980).

EXPLANATION OF PLATE 1

Late Devonian conodonts from unit 4 of the Crystal Pass Member of the Sultan Limestone at the north end of Iceberg Ridge, Arizona. Specimens are housed in the paleontology collections, Department of Geology, Brigham Young University.

Fig. 1.—*Pelekysgnathus inclinatus* Thomas. Lateral view, X 53, BYU 2948. Fig. 2.—*Apatognathus ? cuspidata* Varker. Inner lateral view, X 80, BYU 2954. Fig. 3.—*Bispathodus stabilis* (Branson and Mehl), Morphotype 2. View of upper surface, X 64, BYU 2923. Figs. 4, 6, 8, 10.—*Polygnathus* sp. 4, lateral view of M element, X 80, BYU 2924; 6, Pb element, X53, BYU 2925; 8, Sa element, posterior view, X 60, BYU 2926; 10, Sc element, X80, BYU 2927. Fig. 5.—*Scaphignathus* sp. Oblique upper view, X 65, BYU 2928. Fig. 7.—*Bispathodus bispathodus* Ziegler, Sandberg and Austin. X 53, BYU 2929. Figs. 9, 11.—*Clydagnathus ormistoni* Beinert, Klapper, Sandberg and Ziegler: 9, oblique inner lateral view, X 42; 11, upper view of same specimen, X 42, BYU 2930. Figs. 12–14.—*Icriodus ? raymondi* Sandberg and Ziegler: 12, upper view, X 100; 14, lower view of same specimen, X 106, BYU 2931; 13, lateral view, X 80, BYU 2932. Fig. 15.—*Icriodus costatus* (Thomas). Oblique upper view, X 66, BYU 2933. Figs. 16, 21, 22.—*Polygnathus subirregularis* Sandberg and Ziegler: 16, upper view of immature specimen, X 60, BYU 2934; 21, lower view, X 64; 22, upper view of same specimen, X 64, BYU 2935. Fig. 17.—*Polygnathus semicostatus* Branson and Mehl. Oblique upper view, X 70, BYU 2936. Figs. 18, 19.—*Polygnathus perplexus* (Thomas): 18, upper view, X 48; 19, lower view of same specimen, X 48, BYU 2937. Fig. 20.—*Polygnathus experplexus* Sandberg and Ziegler. Upper view, X 48, BYU 2938.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The *typicus* Zone is followed upward by a 157 m barren interval that ranges through the upper Redwall and lowest Watahomigi Formations and encompasses the mid-Carboniferous boundary. Conodonts are present within a dolostone (unit 10 of Beus 1979) that overlies the "red siltstone." An abundant Pennsylvanian conodont fauna characterized by *Declinognathodus nodiluferus, Adetognathus spathus, A. lautus, Rhachistognathus muricatus,* and *Idiognathodus* sp. is present 20 m above the base of the dolostone unit. The evolutionary first occurrence of *D. noduliferus* marks the mid-Carboniferous boundary (Lane and Manger 1985). These faunas indicate that carbonate units 10–15 of Beus (1979) are Pennsylvanian rather than Mississippian in age and substantiate McKee's (1981) assignment of these units to the Pennsylvanian System. The absence of fossils in the upper part of the Redwall Limestone and in the "red siltstone" prohibits exact placement of the mid-Carboniferous boundary at Iceberg Ridge.

REGIONAL RELATIONSHIPS

Late Famennian rocks of the Lower *expansa* Zone have been precisely correlated over much of the western and southwestern United States by Sandberg and various coauthors (Sandberg 1976, Sandberg and Poole 1977, Sandberg and others 1989). The reader is referred to Sandberg and others (1989) for a detailed correlation of late Famennian formations in the western United States. Rocks of this zone were deposited during a brief eustatic rise in sea level that flooded large areas of the craton west of the Transcontinental Arch (Sandberg and others 1989, fig. 17). This eustatic sea-level rise initiated T-R cycle IIf of Johnson and Sandberg (1989). The discovery of the Crystal Pass Member at Iceberg Ridge extends the known limits of this upper Famennian depositional complex into northwestern Arizona.

Efforts to trace the Crystal Pass Member of the Sultan in areas immediately adjacent to Iceberg Ridge met with varying degrees of success. As a rule, the Crystal Pass could be located in areas immediately west (toward the type section just southwest of Las Vegas, Nevada) and northwest of Iceberg Ridge. Attempts to trace the Crystal Pass eastward across the Grand Wash Cliffs and into the western Grand Canyon were less fruitful. The Crystal Pass was not located in sections studied along the southern Grand Wash Cliffs (section 31, T. 30 N, R. 15 W, Grapevine Canyon, Arizona 7½-Minute Quadrangle) and at the head of Meriwhitica Canyon (Music Mountains NE, Arizona 7½-Minute Quadrangle).

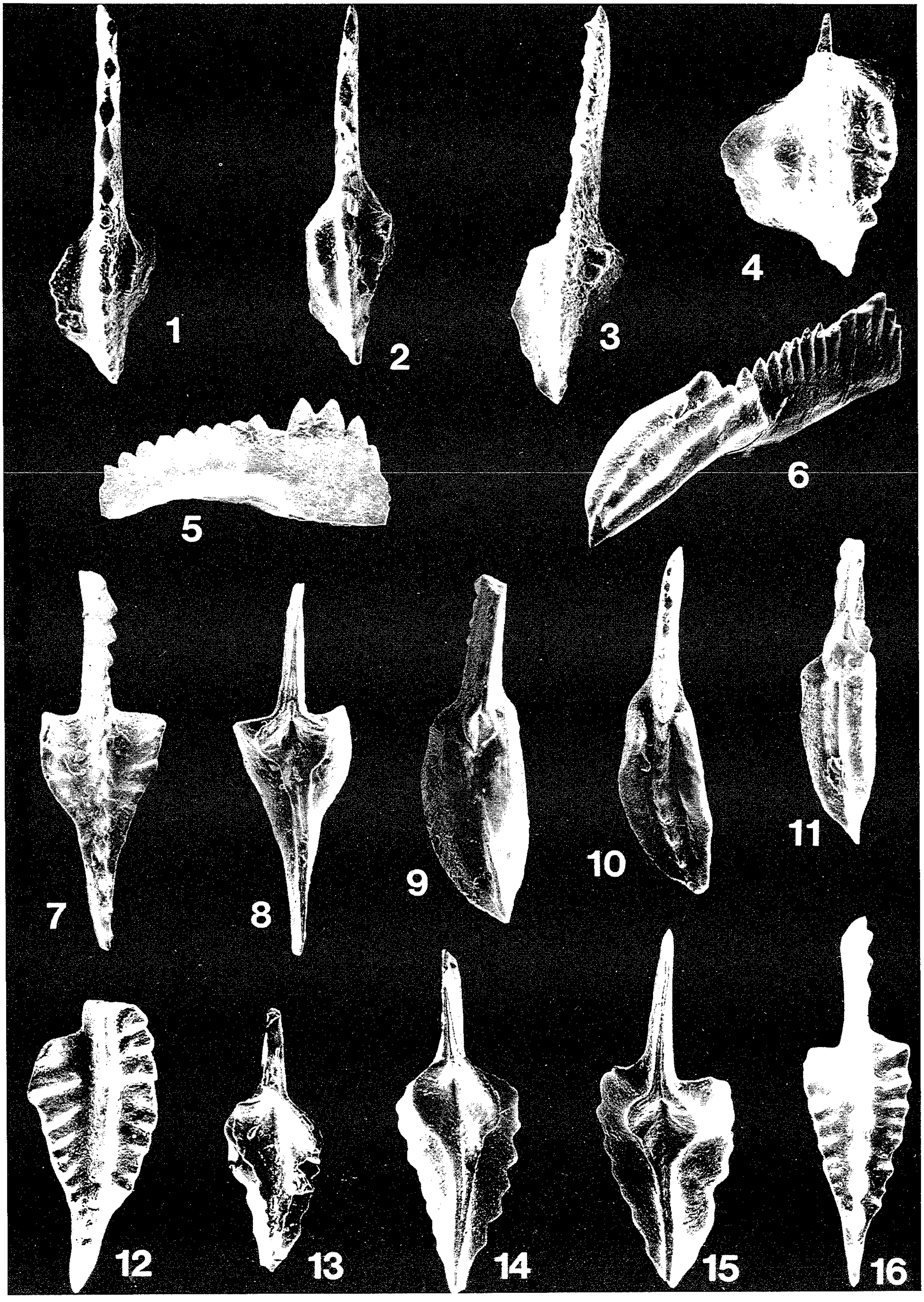
The lack of fossils in much of the Redwall Limestone at Iceberg Ridge limits precise regional correlations. The age of the barren lower and upper intervals (below and above the *typicus* Zone) may be inferred, however, from faunal studies at other Redwall localities (McKee and Gutschick 1969, Norby 1971). In addition, Racey (1974) reported Kinderhookian species of the conodont genus *Siphonodella* from the basal Redwall Limestone along the Mogollon Rim of east central Arizona.

The occurrence of *typicus* Zone conodonts in the upper

EXPLANATION OF PLATE 2

Gnathodus typicus *Zone conodonts from the north end of Iceberg Ridge, Arizona. Figures 12–16 are from the upper Whitmore Wash Member of the Redwall Limestone. All other specimens are from the Thunder Springs Member of the Redwall. Specimens are housed in the Department of Geology, Brigham Young University.*

Figs. 1, 3.—*Gnathodus typicus* Cooper, Morphotype 1: 1, upper view, 31.5 m above the base of Thunder Springs, X 116, BYU 2939; 3, upper view, 24 m above base of Thunder Springs, X 116, BYU 2940. Figs. 2, 4.—*Gnathodus delicatus* Branson and Mehl: 2, upper view, 28.5 m above base of Thunder Springs, X 104, BYU 2941; 4, upper view, 2.5 m above base of Thunder Springs, X 116, BYU 2942. Fig. 5.—*Bispathodus stabilis* (Branson and Mehl), Morphotype 1. Lateral view, X 93, BYU 2943. Figs. 6, 9–11.—*Polygnathus communis communis* Branson and Mehl: 6, oblique upper view, X 58, BYU 2944; 9, lower view, X 75, BYU 2945; 10, upper view, X 73, BYU 2946; 11, lower view of juvenile specimen with large basal pit, X 110, BYU 2947. Fig. 12.—*Pseudopolygnathus multistriatus* Mehl and Thomas, Morphotype 2. Upper view, 28 m above base of the Whitmore Wash, X 40, BYU 2949. Figs. 13–16.—*Pseudopolygnathus oxypageus* Lane, Sandberg, and Ziegler, Morphotype 2: 13–15, lower views showing relative decrease in size of basal cavity during ontogeny, X 87, X 73, X 58, respectively, BYU 2950, 2951, 2952; 16, upper view, X 58, BYU 2953. All specimens from 30 m above base of the Whitmore Wash Member of the Redwall Limestone.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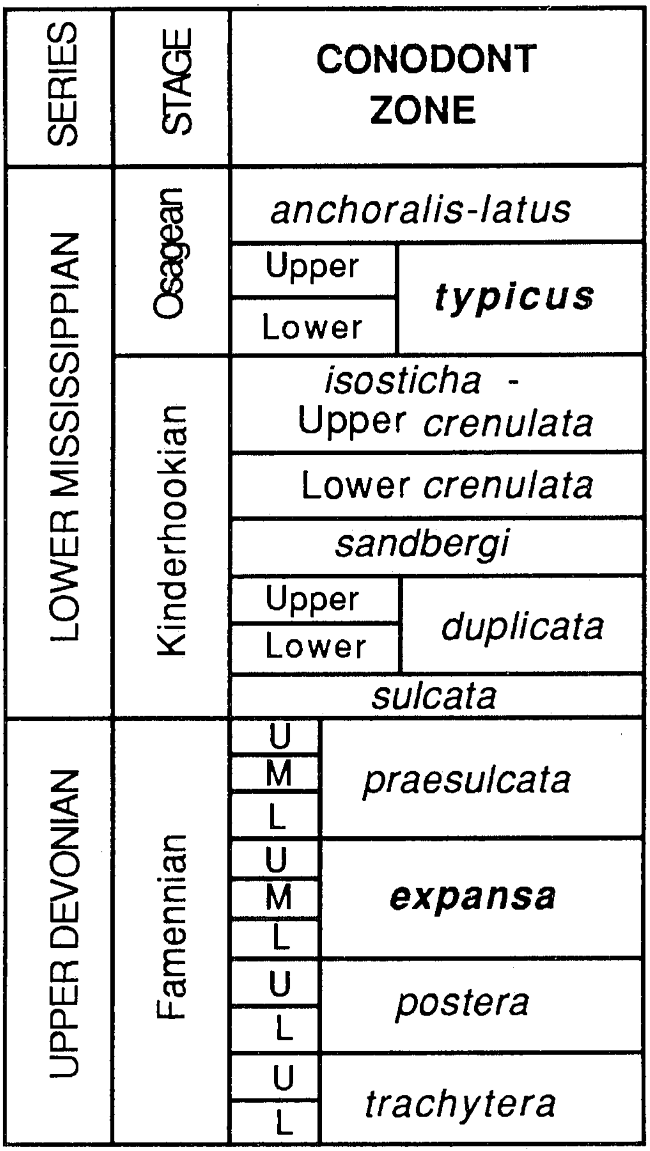

FIGURE 6.—*Composite standard Upper Devonian and Lower Mississippian conodont zonation (compiled from Lane and others 1980, Sandberg and others 1978, and Ziegler and Sandberg 1984).*

Whitmore Wash, Thunder Springs, and lowest Mooney Falls Members permits regional correlation of these units. Equivalent lithostratigraphic units in southern Nevada are the upper Dawn and Anchor Formations of the Monte Cristo Group (Pierce and Langenheim 1974). The *Polygnathus communis communis–Pseudopolygnathus multistriatus* and *Polygnathus communis communis* Zones of Norby (1971) in the lower central part of the Escabrosa Limestone of southeastern Arizona are largely equivalent to the *typicus* Zone. Moore and Barrick (1988) recently described the distribution of *typicus* Zone conodonts in the upper Bugle and lower Witch Members of the Keating Formation in the Big Hatchet Mountains of southwestern New Mexico. The correlation of this interval in Utah, Nevada, and Idaho has been discussed previously by Sandberg and Gutschick (1979), Norris (1981), and Sando and others (1976).

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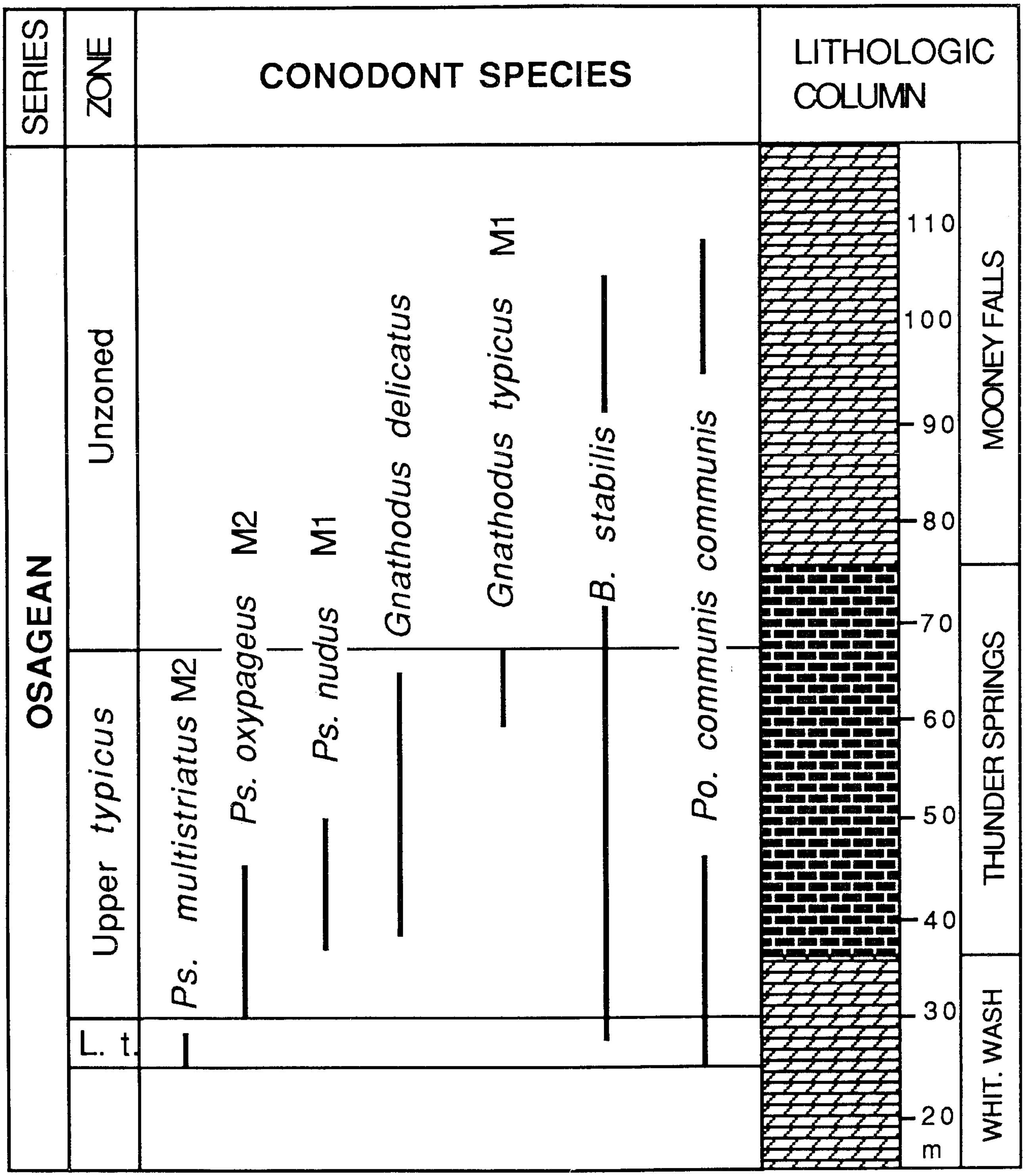

FIGURE 7.—*Stratigraphic distribution of selected Mississippian conodonts in the Redwall Limestone at Iceberg Ridge. Zonation after Lane and others (1980).*

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