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George J. Verville, George A. Sanderson, and Mary E. Madsen
1986, pp. 215-223. https://doi.org/10.56577/FFC-37.215

in:

Truth or Consequences Region, Clemons, R. E.; King, W. E.; Mack, G. H.; Zidek, J.; [eds.], New Mexico Geological Society 37th Annual Fall Field Conference Guidebook, 317 p. https://doi.org/10.56577/FFC-37

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PENNSYLVANIAN FUSULINIDS FROM THE FRA CRISTOBAL RANGE, SIERRA COUNTY, NEW MEXICO

GEORGE J. VERVILLE[1], GEORGE A. SANDERSON[2] and MARY E. MADSEN[3]
[1]Consulting Geologist, 8248 E. 35th St., Tulsa, OK 74145; [2]Amoco Production Co., P.O. Box 3385, Tulsa, OK 74102;
[3]Amoco Production Co., 1670 Broadway St., Denver, CO 80202

Abstract—Abundant fusulinid faunas occur throughout most of the Pennsylvanian rocks exposed in the Fra Cristobal Range. The important fusulinid genera represented are *Fusulinella*, *Fusulina* (*Beedeina* of some authors), *Wedekindellina*, *Eowaeringella*, *Triticites*, and *Dunbarinella*. These fusulinids range from late Atokan to late Virgilian in age. The stratigraphic succession of the species present is shown and their local and regional biostratigraphic significance is discussed.

INTRODUCTION

The Fra Cristobal Range is an eastward-tilted fault block which borders the east side of the Rio Grande valley in north-central Sierra County. The most northerly end of the range extends a short distance into the southern part of Socorro County. Pennsylvanian rocks unconformably overlie Precambrian rocks in the northern part of the range and progressively overlap Cambrian (Bliss Sandstone) and Ordovician (El Paso Formation) to the south. Kottlowski (1960) indicated that in the northern part of the range, the Pennsylvanian rocks are about 490 m thick. He also stated that there is a 5–6 m section of red shales and limestones at the top of the Pennsylvanian which grades upward into the red clastics of the Abo Formation. Cserna (1956) subdivided the Pennsylvanian section in the Fra Cristobal Range into three mappable units. These are: a basal shaly unit 81 m thick, a lower unit (with an upper cherty subunit) 331 m thick, and an upper, light-gray, limestone unit 81 m thick. Total thickness is 493 m. These workers did not subdivide the Pennsylvanian section or correlate it with the standard Pennsylvanian series. Our reconnaissance of the Pennsylvanian rocks in the Fra Cristobal Range was undertaken because of the absence of usable biostratigraphic information in the literature.

Abundant fusulinid faunas collected during the course of the reconnaissance study are illustrated in this paper. These faunas are biostratigraphically significant and enable us to recognize the standard Pennsylvanian series and to correlate them locally and regionally. *Fusulinella*, *Fusulina* (*Beedeina* of some authors), *Wedekindellina*, *Eowaeringella*, *Schubertella*, *Triticites*, *Kansanella*, and *Dunbarinella* are the most important fusulinid genera present. They indicate that rocks of late Atokan, Desmoinesian (Cherokee and Marmaton), Missourian (Kansas City–Lansing), and Virgilian (Shawnee and early Wabaunsee) age occur in the Fra Cristobal Range. The stratigraphic positions of the species identified, their age, and their correlation are shown on generalized lithologic logs (Figs. 3–7). Index and topographic maps (Figs. 1, 2) show the geographic setting of the Fra Cristobal Range and the location of our measured sections.

DISCUSSION

The total composited thickness of our measured sections is about 396 m. Our sections were measured south of where Cserna (1956) did his work and represent a composite of several offset traverses necessitated by precipitous limestone cliffs. A few faults were encountered, but most of them appear to be of minor significance. The major differences between our sections and those measured by Cserna (1956) appear to be related to the unconformity at the base of the Pennsylvanian. Cserna's basal unit (81 m) contains several thick shales which appear to be absent in our section. The basal part of the Pennsylvanian, where it is Atokan in age, is known to contain thick shales to the north of the Fra Cristobal Range. In our section, the Atokan is slightly over 10 m thick and only the uppermost part of the series is represented. Apparently, there was some topographic relief at the basal unconformity where we measured our section, which was not overlapped by Pennsylvanian sediments until latest Atokan time.

No rocks of Morrowan or early Atokan age are present in our sections. The absence of Morrowan strata is not unexpected as they are generally regarded to be absent in the southern Rio Grande valley north of the Franklin Mountains. However, sections that include early Atokan strata are known from nearby areas in the Mud Springs Mountains, Caballo Mountains, Derry Hills, and Joyita Hills. The absence of all but the uppermost part of the Atokan in the Fra Cristobal Range substantiates the presence of a topographic high during most of Atokan time.

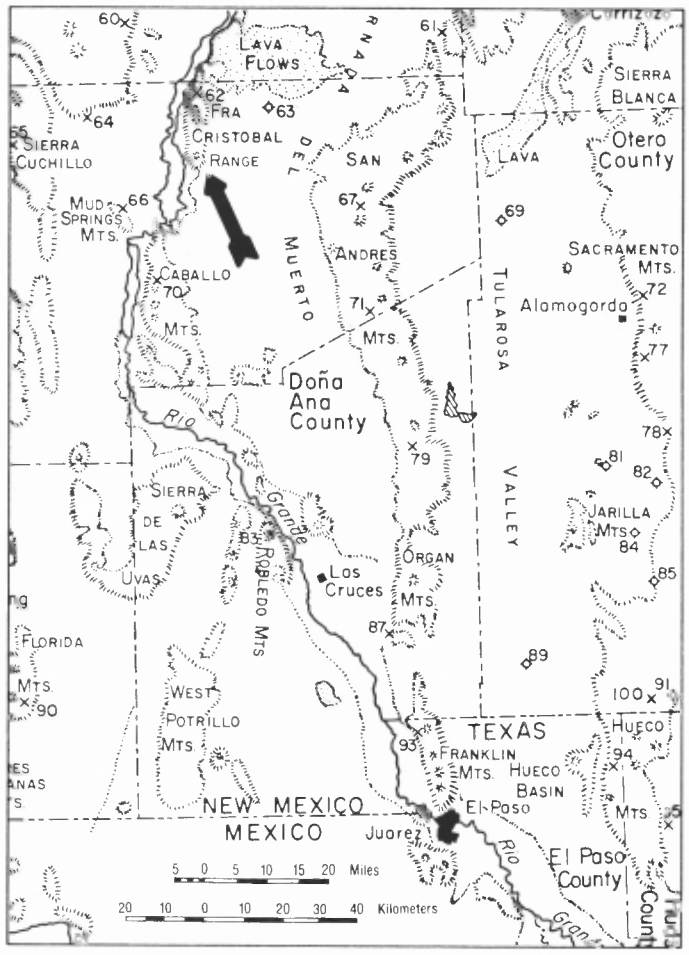


FIGURE 1—Index map of study area (after Kottlowski 1960).

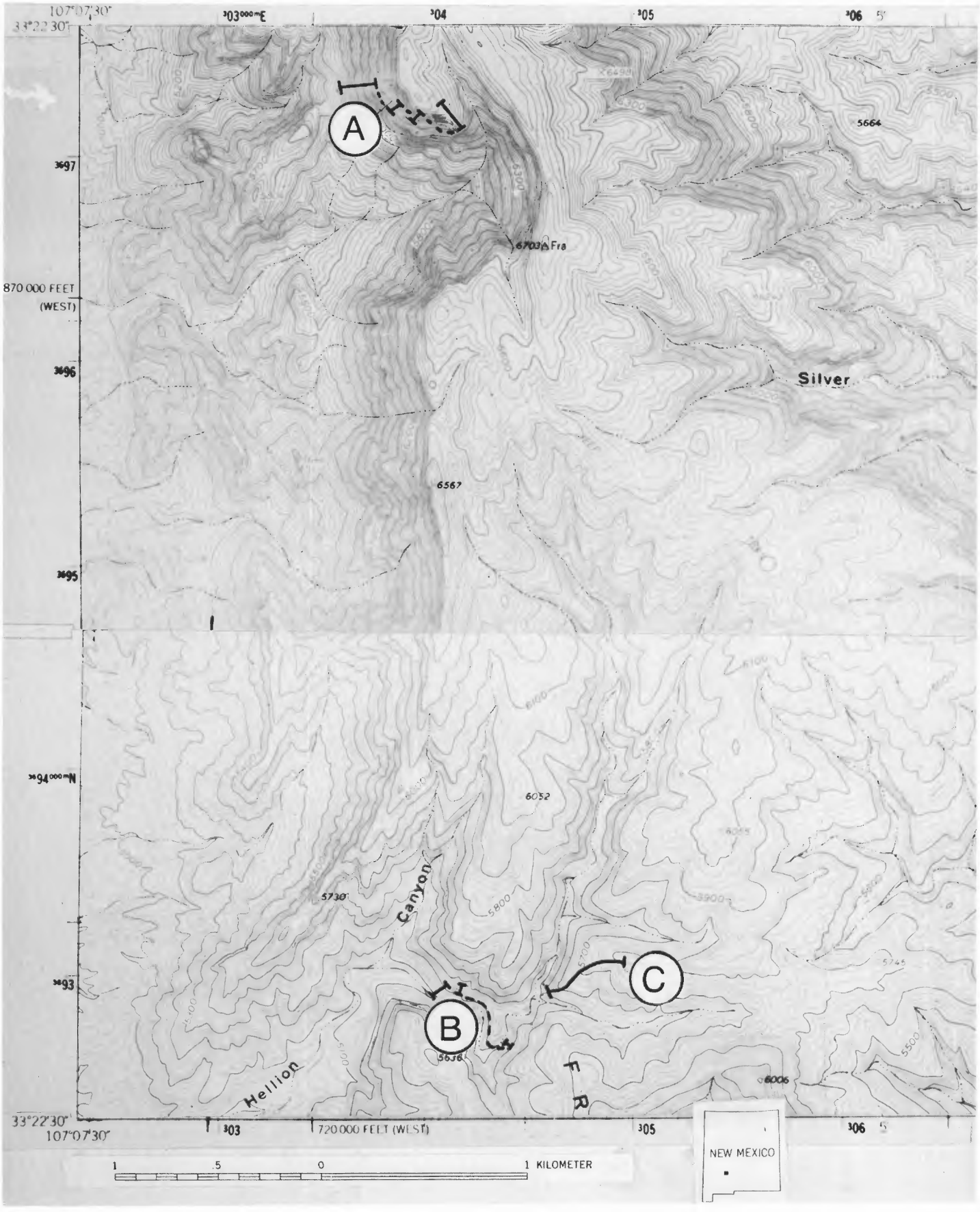


FIGURE 2—Location of measured sections in Fra Cristobal Range.

Atokan

Atokan rocks are poorly represented in the Fra Cristobal Range where we measured our sections. The late Atokan sequence, which unconformably overlies the Bliss Formation, consists of thin- to medium-bedded, nodular, fossiliferous, gray limestones interbedded with gray to grayish-green platy shales. These rocks are only 10 m thick. *Fusulinella juncea* Thompson occurs at 5 and 7 m above the base of the Atokan section (Fig. 3). *F. juncea* was originally described by Thompson (1948) from the upper part of the Cuchillo Negro Formation in the Mud Springs Mountains. This species was also reported by Thompson (1948) in the uppermost part of the Atokan in Derry Hills. We have identified *F. juncea* in late Atokan rocks in the Berino Formation at Bishop Cap, Doña Ana County, and at the top of the Red House Formation in the Caballo Mountains. *F. juncea* was reported by Stewart (1970) in Atokan rocks in the Joyita Hills, Socorro County. Our abnormally thin late Atokan section is considered to be equivalent to the upper part of the basal shaly subunit of Cserna (1956).

Desmoinesian

Rocks assigned to the Desmoinesian Series, which appear to be equivalent to the cherty subunit of Cserna (1956), are slightly over 260 m thick in our sections. Because of the presence of diagnostic fusulinid faunas, we have been able to identify about 153 m of early Desmoinesian (Cherokee equivalent) and about 107 m of late Desmoinesian (Marmaton equivalent) rocks in the Fra Cristobal Range.

Early Desmoinesian (Cherokee)

Most of the limestones in the lower part of the Desmoinesian are micritic or silty, cherty, and are commonly interbedded with thin, gray to greenish shales which are often very silty. Many of the limestones are highly fossiliferous, with fusulinids, bryozoans, crinoidal debris, and brachiopods being the most common fossil elements. A prominent occurrence of silicified horn corals (*Caninia*) is present about 11 m above the base of the Desmoinesian. The distinctive bryozoan *Prismopora* is common at 76 m above the base of the Desmoinesian, and phylloid algae occur at several stratigraphic levels. A prominent, brown-weathering, sandy to conglomeratic, crossbedded limestone with reworked chert and fossil debris occurs about 92 m above the base of the Desmoinesian.

Abundant fusulinid faunas are found throughout most of the early Desmoinesian. *Fusulina insolita* Thompson occurs about 3 m above the base of the Desmoinesian (Fig. 3). This primitive species of *Fusulina* is an excellent biostratigraphic marker for the earliest Desmoinesian, and it occurs in basal Desmoinesian rocks in almost every mountain range from the Joyita Hills in Socorro County southward to Bishop Cap, Doña Ana County, New Mexico. Other Cherokee species are *Wedekindellina euthysepta* (Henbest), *W.* aff. *elongata* Stewart, *W. ellipsoides* Dunbar & Henbest, *Fusulina novamexicana* Needham, and three undescribed species of *Fusulina* (Figs. 3, 4).

Late Desmoinesian (Marmaton)

Rocks assigned to the late Desmoinesian are about 107 m thick (Fig. 4). The limestones of the Marmaton appear to have been deposited in slightly shallower water than those of the Cherokee. Occurrences of *Osagia*, coated grains, and encrusting foraminiferal packstones and grainstones confirm a shallow marine environment. In our traverse, no fusulinids were found in the interval from 212 to 260 m above the base of the Desmoinesian (Fig. 4). Diagnostic fusulinids may well be present in this interval, but the precipitous nature of the limestone cliffs prevented anything but a cursory search. Because of the absence of diagnostic fusulinid species in our collections, the top of the Desmoinesian cannot be determined precisely. The principal reason for picking the top of the Desmoinesian at 260 m above the base of the Desmoinesian is the primitive nature of the lowest occurrence of *Triticites* at 272 m. These *Triticites* closely resemble species which occur only a few meters above the base of the Missourian in our southern traverses east of Hellion Canyon (Fig. 2).

Fusulina haworthi (Beede), a species characteristic of the Marmaton, occurs at 190 and 210 m above the base of the Desmoinesian (Fig. 4). *Fusulina* aff. *tumida* Alexander occurs about 65 m below the top of the Desmoinesian at the base of one of our traverses east of Hellion Canyon (Fig. 6). *F. tumida* and *F. haworthi* also occur in the Caballo Mountains. The top of the Desmoinesian, in the southern traverse at Section B (Fig. 2), is picked at a prominent brecciated zone which occurs a short distance below the occurrence of *Eowaeringella*, an excellent biostratigraphic marker for the early Missourian (Swope Limestone of the Kansas City Group) (Fig. 6).

Missourian

Rocks assigned to the Missourian Series are about 60 m thick. They consist mainly of light-gray, medium- to thick-bedded limestones which are less cherty than the limestones in the underlying Desmoinesian. Encrusting foraminifers are relatively common in the upper 30 m. In the northern traverse (Section A, Fig. 2), our measurements are not entirely reliable above the base of the Missourian. Our most accurate Missourian measurements were obtained a few kilometers to the south in a tributary canyon east of Hellion Canyon (see Fig. 2 for the location of Sections B and C).

Triticites burgessae Burma, *T. nebraskensis* Thompson, and *T. ohioensis* Thompson were found in Section A (Figs. 2, 5). These primitive species provide a reliable correlation between our northern and southern traverses. In Section B, of our southern traverse, in addition to the occurrence of *T. burgessae* Burma and *T. ohioensis* Thompson, we also found *Eowaeringella* sp. in rocks only a few meters above our placement of the base of the Missourian (Fig. 6). The fusulinids from Section C (Fig. 2) are *Triticites nebraskensis* Thompson, *T. ohioensis* Thompson, and *T. liosepta* Stewart (Fig. 7). Lansing *Triticites* were found only in Section C. Species present are *T. newelli* Burma, *T. kawensis* Thompson, and *T. primarius* Merchant & Keroher.

The fusulinid faunas in the Missourian include equivalents of the Swope, Dennis, and Cherryvale Formations of the Kansas City Group and the Stanton Formation of the Lansing Group in the midcontinent area. Much thicker sections of Missourian rocks have been reported in the nearby San Mateo, Mud Springs, and Caballo Mountains. The thin Missourian in the Fra Cristobal Range (60 m) may be a westward extension of the thin Missourian at Rhodes Canyon (59 m) and Hembrillo Canyon (83 m) in the San Andres Mountains (Kottlowski et al. 1956).

Virgilian

Marine Virgilian rocks, only about 50 m thick, grade upward into the red clastics of the Abo Formation. It is possible that the lower Abo red beds are also Late Pennsylvanian in age, but the absence of diagnostic faunas precludes a reliable age assignment. The youngest Virgilian fusulinids in our Fra Cristobal section are no younger than medial Virgilian, so the transition to the red-bed sequence may well have begun in late Virgilian time. The rapid thinning of Virgilian rocks westward from the San Andres Mountains to the Fra Cristobal Range and Caballo Mountains clearly indicates that the area now occupied by these two mountain ranges was located along the western margin of a Late Pennsylvanian sea in south-central New Mexico. Thicknesses of over 610 m of Virgilian rocks are reported in the San Andres Mountains to the east (Kottlowski et al. 1956).

Fusulinid faunas collected from the thin sequence of Virgilian rocks in the Fra Cristobal Range are illustrated in Section C (Figs. 2, 7). Species present are *Triticites* ex. gr. *secalicus* (Say), *Kansanella* sp., *Triticites plummeri* Dunbar & Condra, *Triticites* n.sp., *Triticites* ex. gr. *ventricosus* (Meek & Hayden), *Dunbarinella ervinensis* Thompson, and *Schubertella* sp. These fusulinids are correlative with the upper Shawnee and lower Wabausee Groups of the midcontinent area. *T. plummeri* and *D. ervinensis* also occur in the middle part of the Holder Formation in the Sacramento Mountains, in the middle part of the Panther Seep Formation in the San Andres Mountains, and in the Virgilian section of the Robledo Mountains.

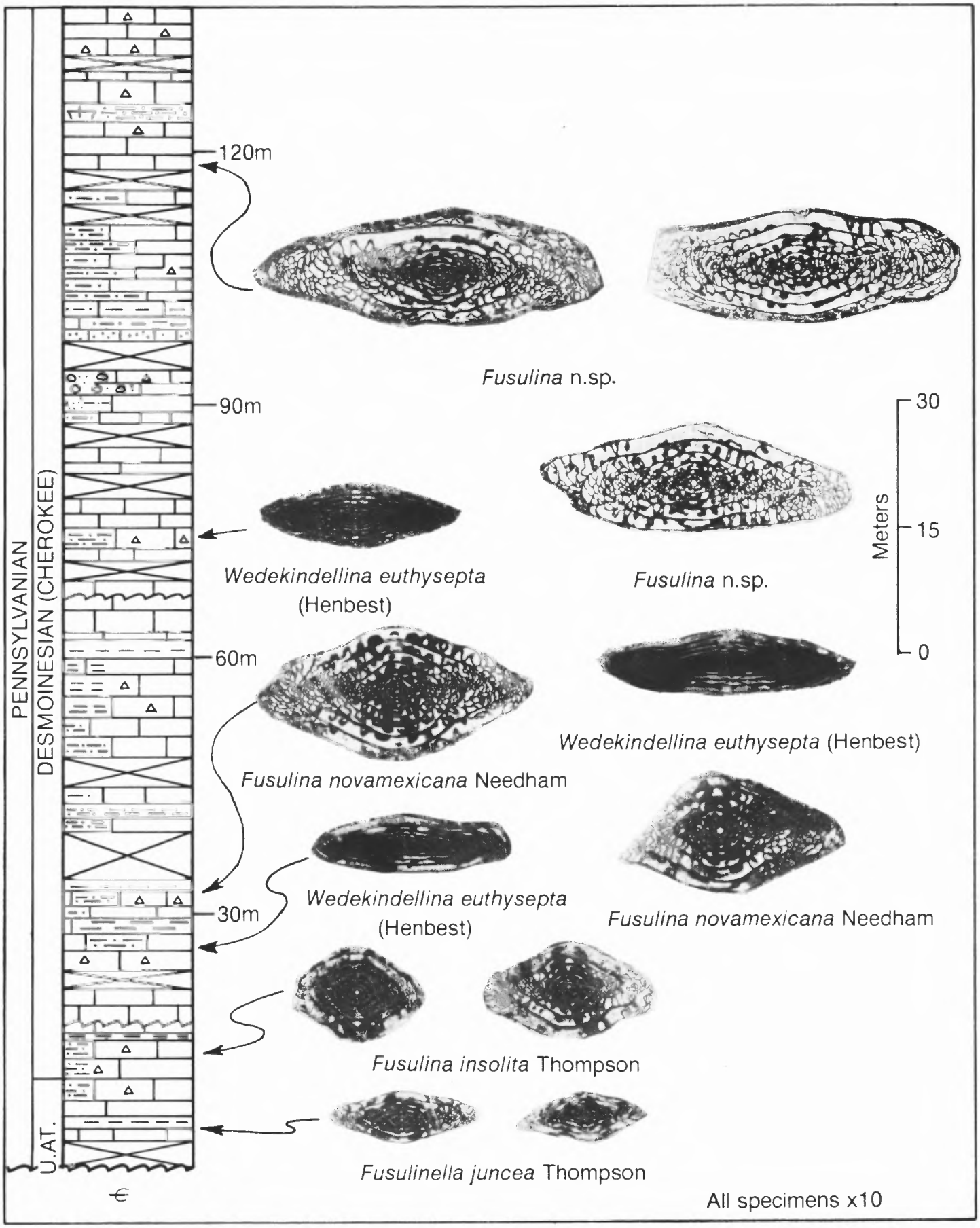


FIGURE 3—Composite Section A (lower part), northern Fra Cristobal Range.

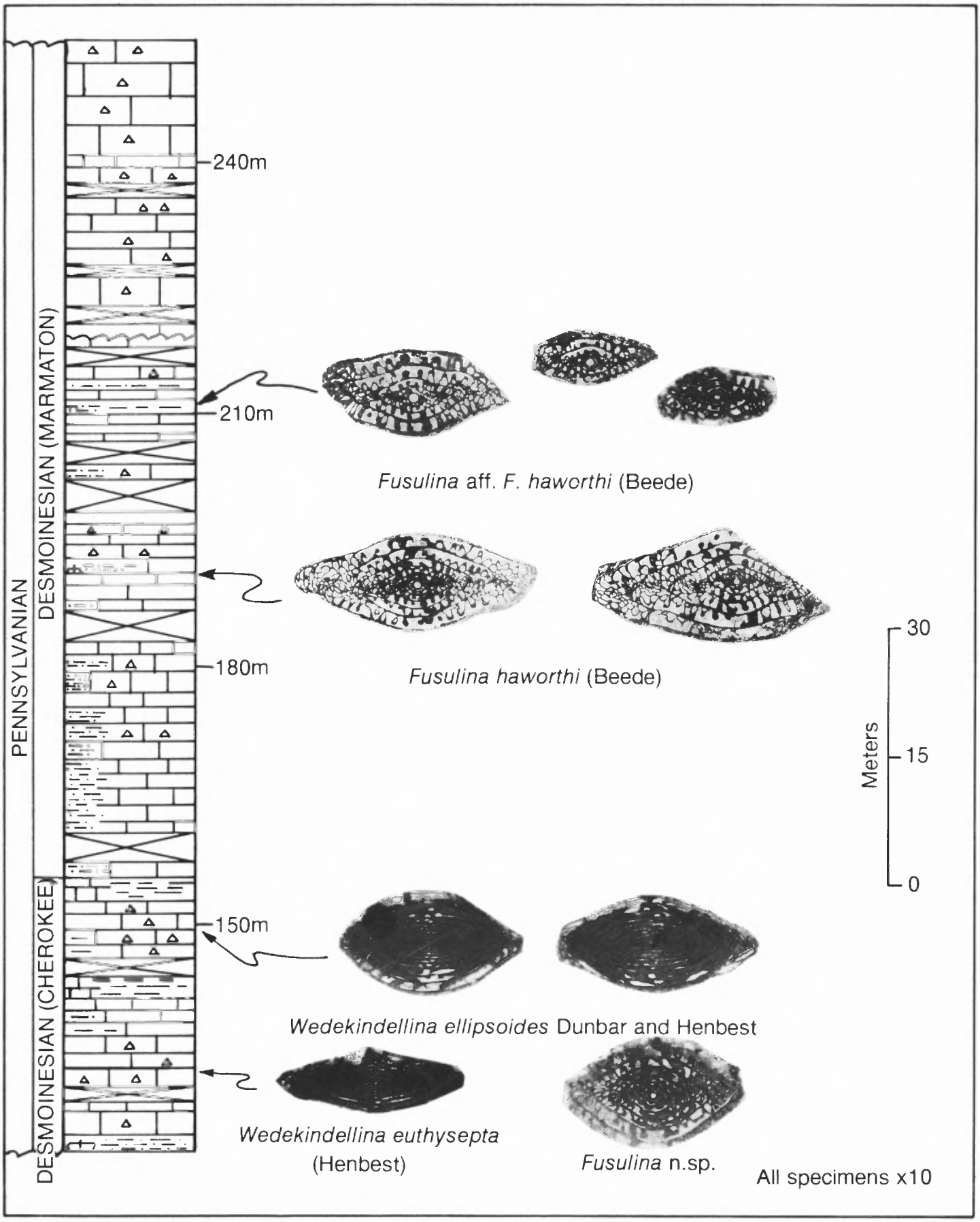


FIGURE 4—Composite Section A (middle part), northern Fra Cristobal Range.

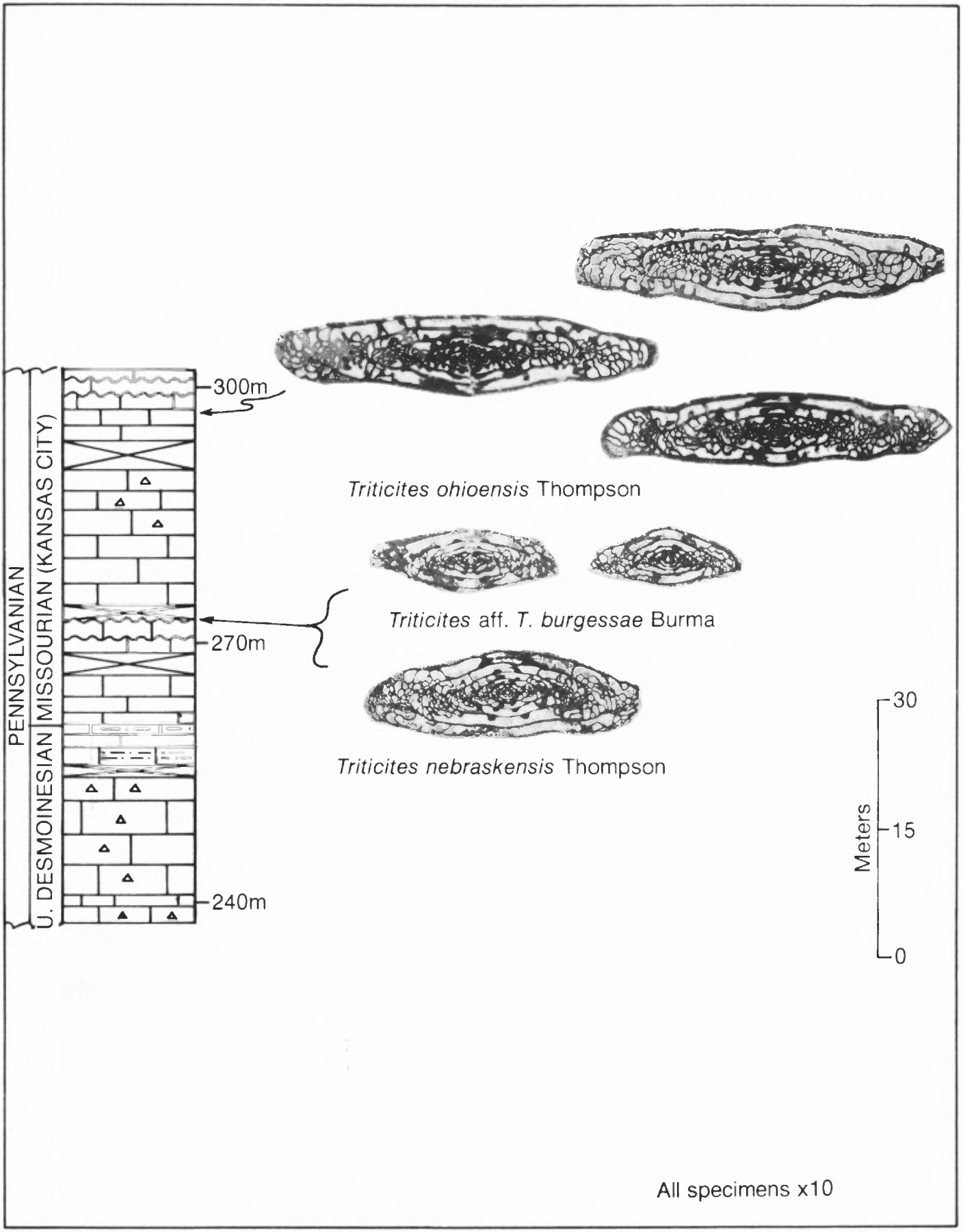


FIGURE 5—Composite Section A (upper part), northern Fra Cristobal Range.

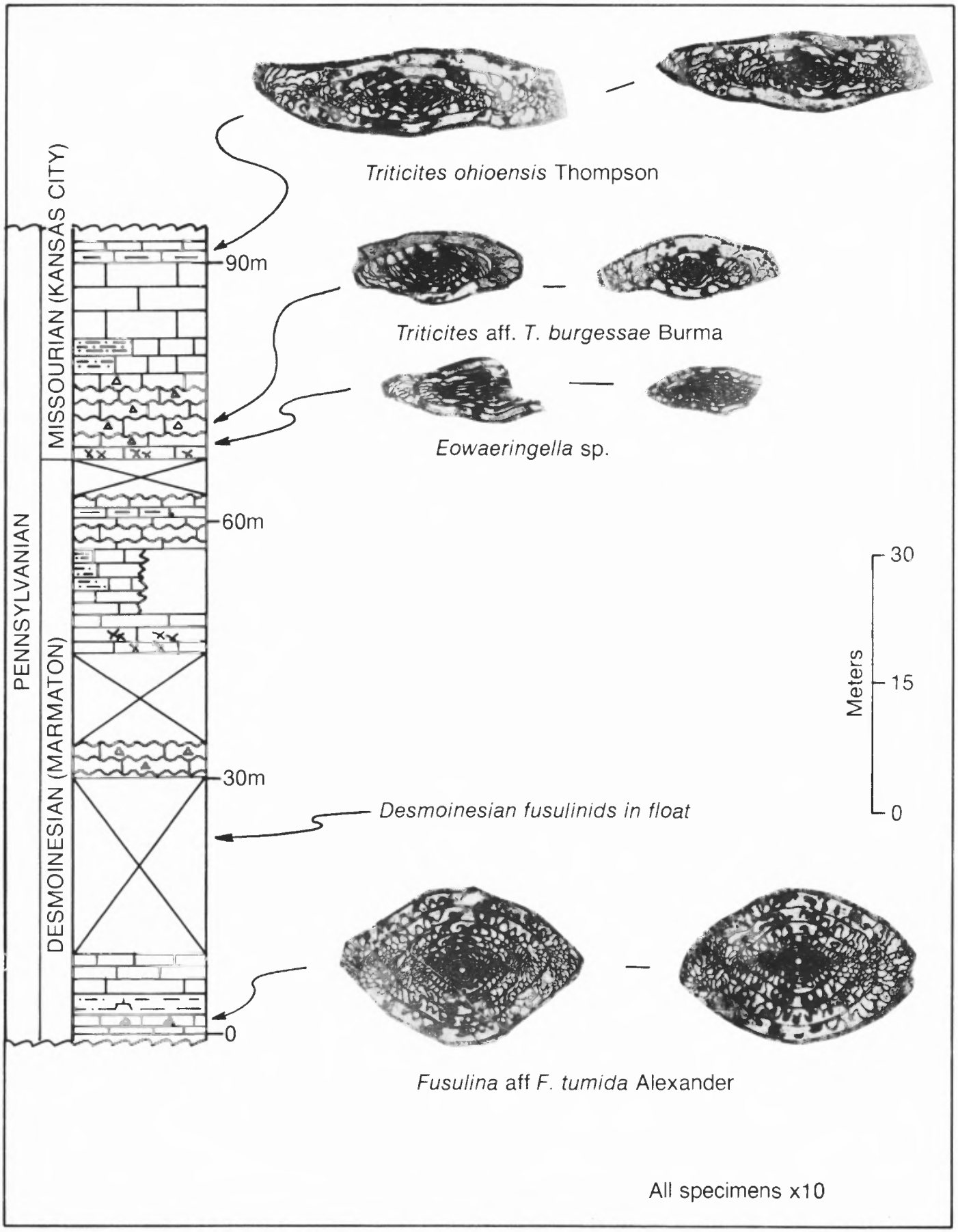


FIGURE 6—Composite Section B, southern Fra Cristobal Range.

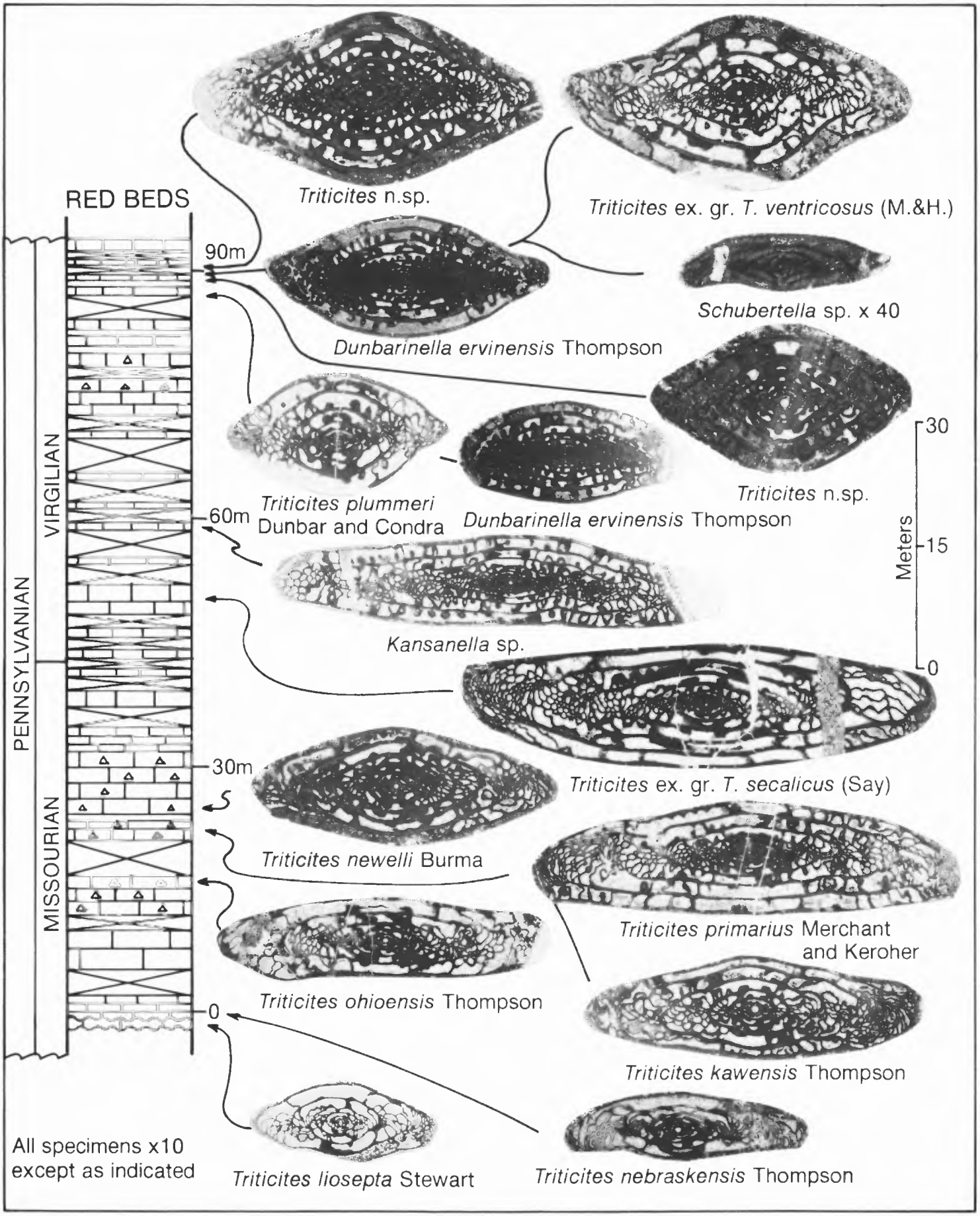


FIGURE 7—Section C, southern Fra Cristobal Range.

CONCLUSIONS

The fusulinid faunas collected during our reconnaissance studies in the Fra Cristobal Range have considerable biostratigraphic significance and indicate that:

1. With the exception of the Morrowan, all of the standard series of the Pennsylvanian can be recognized in the Fra Cristobal Range.

2. An Early Pennsylvanian topographic high existed in the area that is now the northern and central Fra Cristobal Range. At Section A, this high was first overlapped by Pennsylvanian strata in latest Atokan time.

3. Atokan rocks (Section A) are only about 10 m thick and are entirely latest Atokan in age. Thicker, and in most cases more complete, sections of Atokan rocks are known in all of the nearby mountain ranges.

4. Slightly over 150 m of early Desmoinesian rocks are present. These strata contain abundant fusulinid faunas and can be readily correlated with other early Desmoinesian sections throughout south-central New Mexico. They are correlative with the Cherokee Group of the midcontinent area.

5. Late Desmoinesian rocks, correlative with part of the Marmaton Group of the midcontinent area, are about 107 m thick. Late Desmoinesian fusulinids are not common. Although reliable mid-Marmaton species are present, their highest occurrence is about 45 m below the top of the section which we regard as late Desmoinesian in age. Because of the apparent absence of fusulinids in these uppermost beds, we cannot precisely determine the age of these rocks or accurately locate the Desmoinesian–Missourian boundary.

6. Missourian rocks in the Fra Cristobal Range are only about 60 m thick and are comparable in thickness with some of the Missourian sections reported from the nearby San Andres Mountains (Kottlowski et al. 1956). Fusulinids present are characteristic of the lower to middle Kansas City and upper Lansing Groups of the midcontinent area. The thinness of the section and the gaps in the faunal succession suggest that Missourian deposition was discontinuous.

7. Marine Virgilian rocks that contain diagnostic fusulinid species are only about 50 m thick. These rocks grade upward into red beds which may, in part, also be Late Pennsylvanian. The Virgilian fusulinids present are characteristic of the late Shawnee and early Wabaunsee Groups in the midcontinent area. The two most biostratigraphically useful species, *Triticites plummeri* and *Dunbarinella ervinensis*, occur near the top of our marine section between 45 and 50 m above the base of the Virgilian. These species also occur near the middle of the Panther Seep Formation in Rhodes Canyon where the formation is 445 m thick (Kottlowski et al. 1956). The same, or closely similar, species have restricted stratigraphic ranges in Virgilian rocks in the Sacramento, Robledo, and Oscura Mountains and provide us with a reliable biostratigraphic correlation of Virgilian rocks throughout the region.

8. The biostratigraphic information presented in this paper, although based primarily on a reconnaissance study, should permit the Pennsylvanian rocks in the Fra Cristobal Range to be incorporated more readily into biostratigraphic and paleogeographic studies in south-central New Mexico.

ACKNOWLEDGMENTS

We thank Linda Maholland for her able and cheerful assistance in the field. Drs. P.L. Brenckle, J.R. Groves, and W.E. King reviewed the manuscript and made helpful suggestions. Amoco Production Company granted permission to publish this paper and provided support services for which we are grateful.

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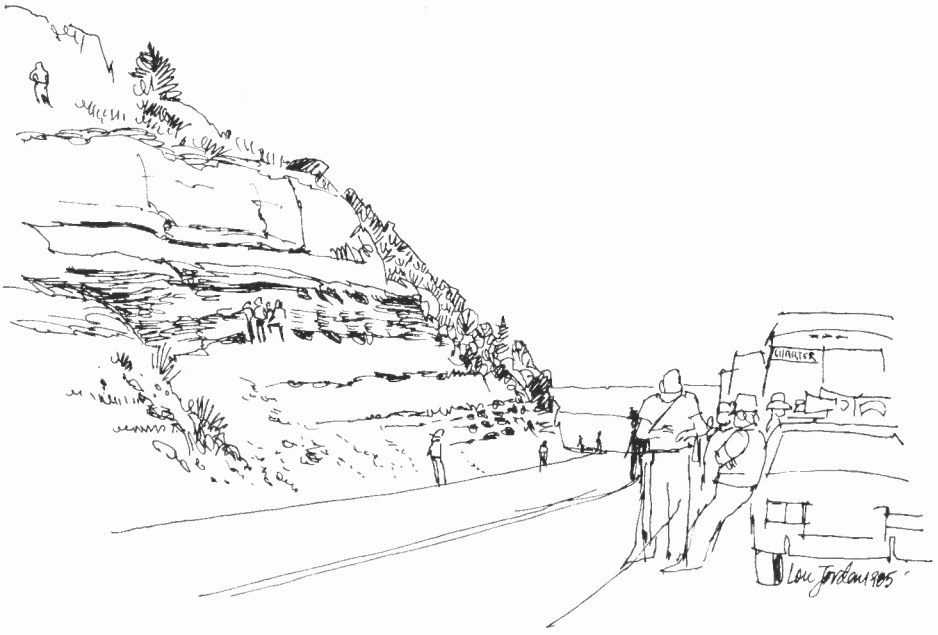
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