Early Triassic (Smithian) Ammonites of Paleo-equatorial Affinity from the Chulitna Terrane, South-central Alaska
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By K. M. Nichols and N. J. Silberling

GEOLOGIC FRAMEWORK OF THE UPPER CHULITNA DISTRICT, ALASKA

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Documentation of an equatorial fauna interpreted to have been tectonically displaced northward

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EARLY TRIASSIC (SMITHIAN) AMMONITES OF PALEOEQUATORIAL AFFINITY FROM THE CHULITNA TERRANE, SOUTH-CENTRAL ALASKA

By K. M. NICHOLS and N. J. SILBERLING

ABSTRACT

Lower Triassic limestone is part of the unique stratigraphic succession of the Chulitna terrane. This terrane is believed to be a greatly displaced lithosphere fragment whose exposures are limited to a 400 km² area on the south flank of the central Alaska Range in Alaska. The nearest known correlative Lower Triassic marine strata are located hundreds of kilometers distant in northern Alaska and northwestern British Columbia; in general, they are not represented elsewhere among the oceanic-volcanic pre-Tertiary sequences of the entire circumpacific margin.

Ammonites are the dominant megafossils in the Lower Triassic limestone of the Chulitna terrane and are represented in a single bed by 13 identifiable species assigned to 13 genera, of which Meekoceras, Dieneroceras, Arctoceras, and Paranannites are the most abundant.

Ammonites in the Chulitna fauna are entirely of species previously described from the western conterminous United States from rocks of early Smithian age that were deposited along the margin of the North American craton at paleolatitudes of about 10° north. The Chulitna fauna is much less similar to faunas of this age from localities in western Canada and the North American arctic, representing paleolatitudes greater than 20° north. Moreover, remnants of the original marine carbonate cement in the ammonite-bearing rock are acicular and evidently formed in warm water; their presence may indicate that the Lower Triassic limestone and associated rocks of the Chulitna terrane were tectonically transported from a site much farther south than their present location.

INTRODUCTION

The Chulitna terrane (Jones and others, 1979) is characterized by a distinctive assemblage of depositionally or tectonically related Paleozoic and Mesozoic rocks. Its exposures are limited to a belt less than 10 km wide and 50 km long in the Upper Chulitna district on the south flank of the central Alaska Range, about 50–75 km east of Mt. McKinley. Despite the limited outcrop area of the terrane, pre-Cretaceous rocks included in it are in strong lithologic contrast with contemporaries in adjacent and nearby terranes, and some parts of the Chulitna terrane have no parallel in Alaska. Jones and others (1979) infer that the Chulitna terrane is a tectonic fragment of a lithosphere plate that formed at a great distance from its present site and has been displaced generally northward.

One of the most unusual features of the Chulitna terrane is the occurrence in it of fossiliferous marine Lower Triassic limestone. Other exposures of correlative marine rocks in North America are limited to settings well inland along the miogeoclinal western and northern edges of the craton. The closest known marine Lower Triassic strata are in northern Alaska and northeastern British Columbia (fig. 1). Both of these regions are at least hundreds of kilometers distant and are separated from the Upper Chulitna district by vast tracts whose complex and varied geology manifests large-scale tectonic displacements.

The purpose of this paper is to document the age of the marine Lower Triassic rocks of the Chulitna terrane on the basis of their ammonite fauna. In addition, the taxonomic character of this fauna is compared with that of other correlative faunas from North America to show that its affinities are with paleogeographically equatorial faunas.

OCCURRENCE

The ammonite-rich Lower Triassic limestone of the Chulitna terrane is known only from three small isolated exposures. One of these (USGS Mesozoic loc. M5027), which is locality 20 of Silberling and others (1978) and of Jones and others (1979, pl. 1), was discovered by Hawley and Clark (1974, pl. 1, loc. 6). Ammonites originally collected from this locality were discussed briefly by Silberling (in Hawley and Clark, 1974, p. B4–B5). This report is based on extensive new collections made in 1976 from this locality, which is a single, steeply dipping bed about 20 cm thick that was exposed for 2–3 m along strike in a bulldozer cut before being quarried away at the surface during collecting. This bed is in the middle part of about 10 m of stratigraphic section represented by scattered, partly artificial exposures of limestone. Nearby outcrops are of basalt and conglomeratic red beds whose age is interpreted as Late Triassic, more Lower Triassic limestone, and fine-grained elastic rocks of probable Permian age.
Relations of these various rocks, which are cut by numerous faults, to the ammonite-bearing Lower Triassic limestone are obscured by poor exposure.

Another exposure of these Lower Triassic rocks, discovered in 1977, is about 2 km west-southwest, at locality 19 of Silberling and others (1978) and of Jones and others (1979, pl. 1). Here, several of the same distinctive species of Smithian ammonites were collected from limestone whose exposed thickness is only about 1 m. A short distance uphill, across a covered interval, is a massive basalt flow about 10 m thick overlain by red conglomeratic sandstone lithologically similar to that of Silberling and others (1978) and of Jones and others (1979). None of the ammonites from these additional Lower Triassic localities represents any species different from those known previously from USGS Mesozoic locality M5027. Consequently, all of the ammonites treated in the present study are from locality M5027, a geographic description of which is:

![Figure 1](https://example.com/figure1.png)

**PALEOGEOGRAPHIC INTERPRETATION**

It is of particular importance for paleogeographic interpretation that the species of Lower Triassic amo-
nites from the Chulitna terrane are entirely the same as those known from the western conterminous United States; few of them are known from correlative faunas at northern latitudes comparable to that of the Alaskan locality. These relations are detailed in table 1, wherein comparison is made with other lower Smithian ammonite faunas from localities scattered north and south along the western and arctic margin of the North American craton. These localities are grouped into those representing equatorial paleolatitudes (less than 20° north) and northern paleolatitudes (more than 20° north). For most of them, their geologic settings assure that they have not been tectonically transported beyond these groupings. The fauna of the Chulitna terrane is compared with the total number of seemingly valid early Smithian genera and species in each of these two latitudinally separate regions. This procedure is used because the actual diversity at all possible levels within the lower Smithian for the entire western and northern margin of the North American craton cannot be known, whereas the diversity of the Chulitna-terrane fauna is known from a single 20-cm-thick bed.

The similarity of the ammonite fauna from the Chulitna terrane with that of the western conterminous United States and its lack of close affinity with that of northern North America are striking. An ammonite-bearing bed exactly like that at locality M5027 in its taxonomic makeup would not be out of place in northeastern Nevada or southeastern Idaho.

Assuming that the faunas on which figure 1 and table 1 are based represent, for both the high and low paleolatitude groups, a random sample for all different levels within the lower Smithian substage, the overall taxonomic diversity for the northern group seems to be significantly lower (by a factor of 0.5 or less) than that for the southern group. This finding matches that of Kummel (1973), who concludes that temperature is probably the primary controlling factor for this diversity pattern. The diversity of the Chulitna fauna from a single bed at one outcrop is about as great as the total known diversity for the entire early Smithian subage in high paleolatitudes of North America. This diversity alone is sufficient to suggest an origin at a relatively low paleolatitude.

Some extension of warm water temperatures into relatively high paleolatitudes in the Pacific basin may have resulted from the particular configuration of oceans and continents during Triassic time as modeled by Donn and Shaw (1977). However, in terms of its taxonomic composition and diversity, the Chulitna-terrane fauna is still more southern in its character than the correlative fauna from northeastern British Columbia, which represents a paleolatitude appreciably lower than that of the present site of the Chulitna terrane in Alaska.

Petrographic examination of the ammonite-bearing bed at locality M5027 in the Upper Chulitna district reveals a distinctive early diagenesis that also suggests an origin in the relatively warm marine waters of low paleogeographic latitudes. Although the original carbonate fabrics of these rocks have been altered to a neomorphic mosaic of medium-crystalline equant calcite, and some of the carbonate has been replaced by silica, local intracrystalline impurities preserve ghosts of an original isopachous acicular carbonate cement (fig. 2). Water from which this cement crystallized was evidently as rich in magnesium as normal marine water and sufficiently warm to have had a relatively high crystallization rate with respect to calcium carbonate. (For example, see Folk, 1973.) Geologically young examples of this kind of carbonate cement are found only at modern-day equatorial latitudes.

On the basis of (1) the overall diversity of its ammonite fauna, (2) the taxonomic comparison of its ammonite fauna with other correlative faunas from known paleolatitudes in North America, and (3) its petrographic character, the Lower Triassic limestone of the Chulitna terrane supports the interpretation that this terrane has been displaced from a site much farther south than its present location.

### Table 1

Comparison of the lower Smithian ammonoid fauna from the Chulitna terrane with ammonoid faunas of the same age from other parts of North America

<table>
<thead>
<tr>
<th>Species</th>
<th>Genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of taxa identified in Chulitna terrane</td>
<td>13</td>
</tr>
<tr>
<td>Taxa from Chulitna also recognized elsewhere:</td>
<td></td>
</tr>
<tr>
<td>In equatorial faunas</td>
<td>13</td>
</tr>
<tr>
<td>In northern faunas</td>
<td>2</td>
</tr>
<tr>
<td>Total number of taxa recognized:</td>
<td></td>
</tr>
<tr>
<td>In equatorial faunas</td>
<td>41</td>
</tr>
<tr>
<td>In northern faunas</td>
<td>17</td>
</tr>
</tbody>
</table>

1 Faunas from localities near the paleoequator of Early Triassic time, shown as localities 5-11 on fig. 1.
2 Faunas from localities north of paleolatitude 20° N. of Early Triassic time, shown as localities 2-4 and 12-16 on fig. 1.

### REFERENCES CITED


Figure 2.—Photomicrographs of limestone from USGS Mesozoic locality M5027, Chulitna district, Alaska. Bar scale = 0.50 mm.

A, Neomorphosed skeletal grainstone with geopetal patches of pelletal micrite. Skeletal fragments are thin-shelled bivalves and ammonites, the outlines of which are preserved as very thin lines of impurities. Shells have been rimmed by two or more generations of intergranular acicular carbonate cement. B, Magnification of A showing two or more generations of fibrous calcite cement. A thin band of first-generation cement is adjacent to the shell fragments. This cement is separated by a fuzzy line of dark impurities from a subsequent thicker band of cement. C, Neomorphosed skeletal grainstone with very thin molluscan shell fragments cemented by intergranular acicular carbonate cement. The calcite cement has been partially replaced by length-fast fibrous chaledony.


PLATES 1–3

Contact photographs of the plates in this report are available, at cost, from U.S. Geological Survey Library, Federal Center, Denver, Colorado 80225
Lower Triassic (Smithian) ammonites from USGS Mesozoic locality M5027, Upper Chulitna district, Alaska.

FIGURES

1–2. USNM 248596.
3. USNM 248597.
4. Suture line (×4) of USNM 248597.

5–9. *Arctoceras tuberculatum* (Smith).
5–6. USNM 248598.
7. Suture line (×5) of USNM 248598.
8–9. USNM 248599.

12–13. USNM 248603 (×2)
14. Suture line (×10) of USNM 248603.

15–16. *Aspenites* cf. *A. acutus* Hyatt and Smith. USNM 248604 (Fig. 16 is a broken cross section).

17. USNM 248605 (×2).
18. Suture line (×10) of USNM 248605.

19–20. USNM 248608.
21. Suture line (×12) of USNM 248608.

22–23. USNM 248600.
24. Suture line (×5) of USNM 248600.

27–29. *Xenoceltites* sp.
27–28. USNM 248607.
29. Suture line (×8) of USNM 248607.

30–32. *Xenoceltites intermontanus* (Smith).
30–31. USNM 248606.
32. Suture line (×9) of USNM 248606.
MEEKOCERAS, ARCTOCERAS, DIENEROCERAS, ASPENITES, OWENITES, XENOCELTITES, AND WYOMINGITES
Lower Triassic (Smithian) ammonites from USGS Mesozoic locality M5027, Upper Chulitna district, Alaska.

1–2. USNM 248612.
3–4. USNM 248613.
5–7. USNM 248614.
8. Suture line (×7) of USNM 248614.
9–10. USNM 248615.


14–24. *Juveniles septentrionalis* Smith
14–15. USNM 248621.
16. Suture line (×8) of USNM 248621.
17–18. USNM 248617.
19–20. USNM 248618.
21–23. USNM 248620.
24. USNM 248619.

25–27. USNM 248622.
28–30. USNM 248623.

31–35. *Parannannites slossi* (Kummel and Steele).
31–32. USNM 248624.
33. Suture line (×9) of USNM 248624.
34–35. USNM 248625.

36–37. USNM 248609.
38. Suture line (×6) of USNM 248609.

39–42. *Lanceolites compactus* Hyatt and Smith.
39–40. USNM 248611.
41–42. USNM 248610.
43. Suture line (×3) of USNM 248610.
PARANANNITES, METUSSURIA, LANCEOLITES, AND JUVENITES
Lower Triassic (Smithian) ammonites from USGS Mesozoic locality M5027, Upper Chulitna district, Alaska.

Figures 1–4. Euflemingites cirratus (White).
1. USNM 248628.
2. USNM 248627.
3. USNM 248626.
4. Suture line (×10) of USNM 248626.