SUSPECTED CARBONIFEROUS ROCKS OF TAVAN HAR, GOBI DESERT, MONGOLIA

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INTRODUCTION

The Zuun Gashuun Formation is located in the Tavan Har area of the eastern Gobi Desert in southeastern Mongolia. The main lithologies of the formation include fossiliferous marble (see figure 1), argillite, and quartzite. The formation was originally mapped as Ordovician, but recent macrofossil evidence points to a younger, Carboniferous age.

The lithologies and fossils indicate that the rocks were probably deposited on a low relief microplate that was subject to oscillating shallow carbonate seas. The microplate was accreted during the late Paleozoic and early Mesozoic as the North China block and Siberian craton came together (Heubeck, 2001).

Figure 1: Fossiliferous, bedded marble in field area.

The goal of this study is to establish a more precise age constraint on the rocks, to correlate rock units, to gain an understanding of the depositional environment of the rocks, and to reconstruct the paleoenvironment and relate it to the geologic history of Mongolia and east-central Asia.

METHODS

Three stratigraphic sections of the Zuun Gashuun Formation were measured and described in order to construct a stratigraphic column and correlate the rock units of the formation. In addition, crinoid-rich marble samples were collected in the field to be processed for conodonts, in hopes of obtaining a more precise age constraints. Lithologic and macrofossil descriptions of hand samples were used to provide further age constraints and reconstruct the paleoenvironment.

AGE AND CORRELATION

The Zuun Gashuun Formation is currently mapped as Ordovician in age. It was originally hoped that conodonts would be found to refine the dates of the supposed Ordovician rocks. Unfortunately the only conodont found was a small fragment of a blade and can not be used for age refinement.

However, macroscopic fossils indicate that the Zuun Gashuun Formation is likely Carboniferous in age. A brachiopod mold displays features of a spiriferid brachiopod, indicating that the rocks are either Carboniferous or Permian. In addition, the abundance and size (see figures 2 and 3) of

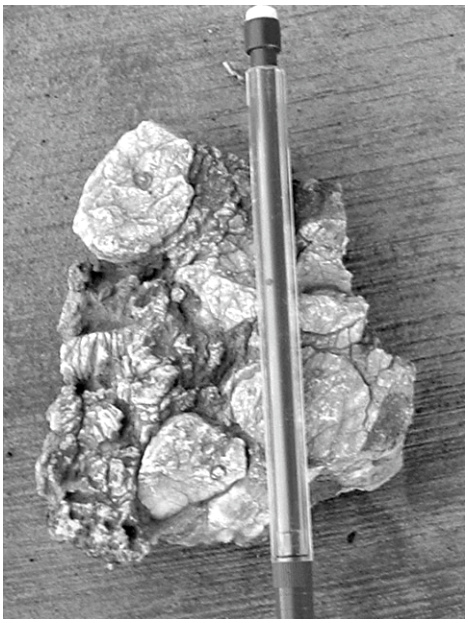

Figure 2: Some of the marble units consist of a carpet of large crinoid stems.

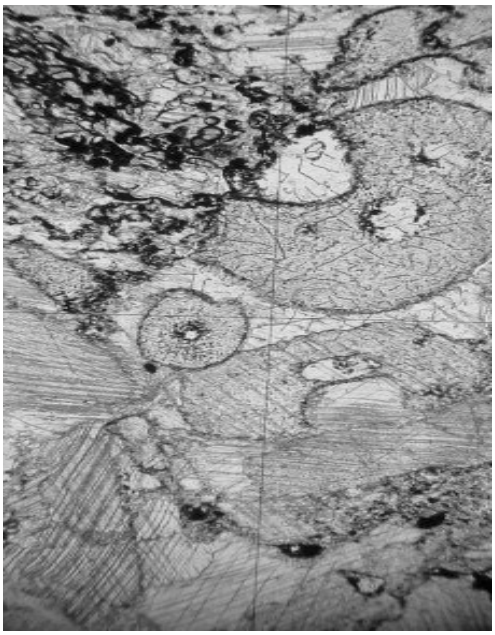

Figure 3: Thin section of a well sorted, crinoid-packed marble.

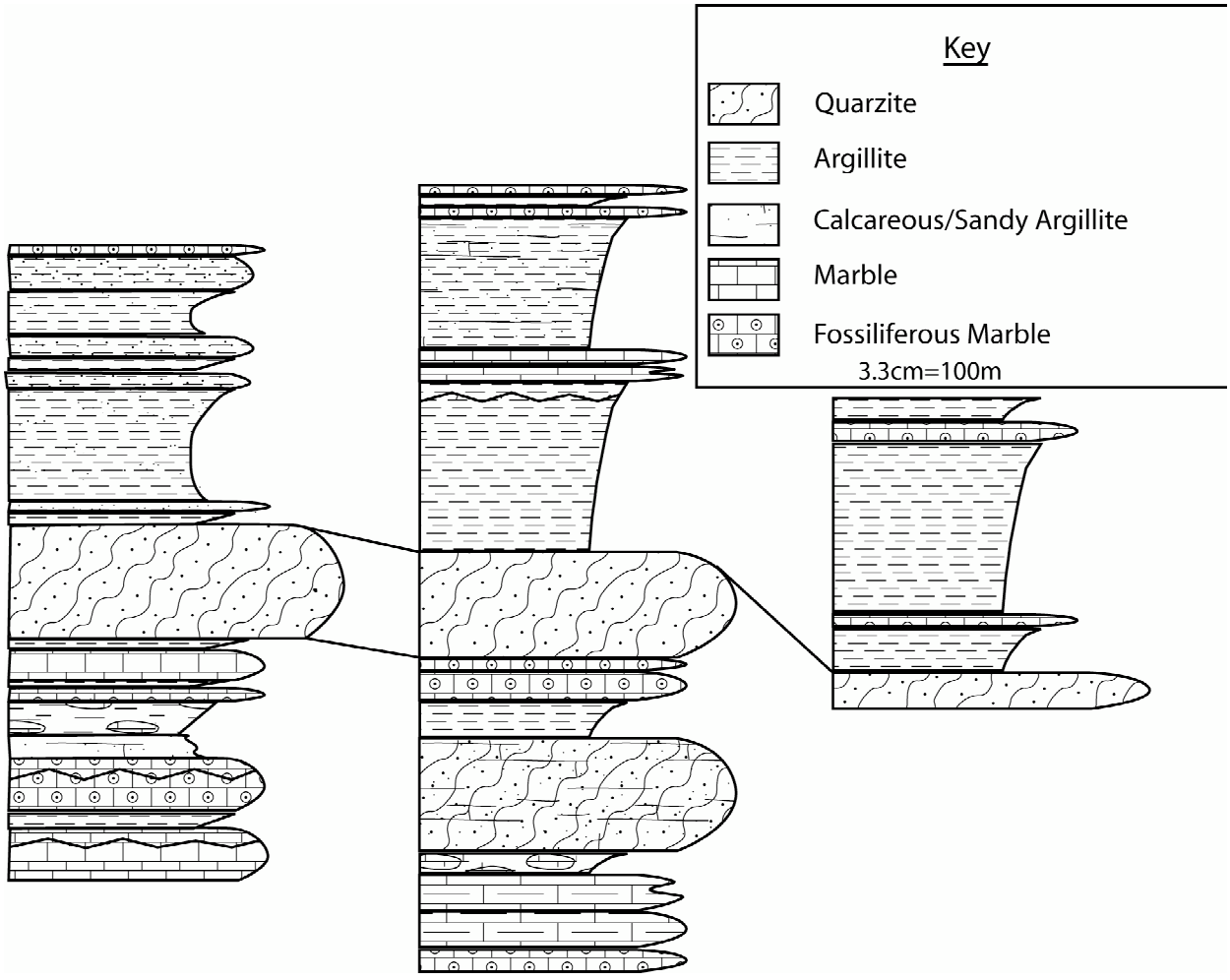

Figure 4: Stratigraphic columns and correlations of three traverses in the Zuun Gashuun Formation.

Figure 5: Papery argillite in field area.

crinoids in the marble suggests that the rocks were deposited in the Carboniferous when crinoids were more profuse. The large crinoids, with stem segments up to approximately two centimeters in diameter (see figure 2), are too big to represent Ordovician crinoids. The crinoid evolutionary pattern of increasing size (Prothero, 1998) raises the possibility that the rocks were more likely deposited later in the Paleozoic.

Figure 4 shows three stratigraphic columns of the Zuun Gashuun Formation. Each stratigraphic column shows a large quartzite unit followed by thick argillite that is often interbedded with thin marble and quartzite lenses. These quartzite and argillite units were found in all three sections and are believed to be correlative.

Most of the marble units are packed biospirites that are well sorted and have abundant crinoids. Brachiopods, bryozoans, and corals are also present to a lesser extent. The quartzite is silty, quartz sand with a slight metamorphic fabric. The grains are angular and well sorted. The argillite appears papery in places (see figure 5), and occurs often with thin lenses of marble or quartzite.

DEPOSITIONAL SETTING

The lithologic units of limestone, sandstone and shale were deposited during transgression and regression of the sea on a small microplate. The units later experienced low-grade metamorphism, which may have occurred during or after the accretion of the microplate. Many of the brachiopods and bryozoans, which are more fragile than crinoids, were probably broken due to wave activity.

The marble protolith was deposited when sea level was relatively high. The well-sorted carbonate indicates that the deposition took place in a shallow, tropical sea that was subject to wave activity.

The argillite protolith was deposited when the relative sea level was slightly lower. The lenses of marble and quartzite represent interplay between sediment supply and small scale oscillations of relative sea level.

The quartzite protolith was deposited when sea level was low, and represents near-shore deposition. The quartzite was terrestrially derived and was probably transported to the sea by braided streams.

The frequent fluctuation of relative sea level indicates that the microplate had low relief that was influenced greatly by small changes in sea level. The composition of the quartzite, marble, and argillite suggests that the core of the microplate was felsic and weathered to quartz and clays.

During the time of the suspected deposition in the Carboniferous, glaciers in Gondwanaland were growing and melting, creating a large scale oscillation of sea level. This may have had an important influence on the deposition of the rocks in the Zuun Gashuun Formation. However, the stratigraphy of the formation represents much more frequent fluctuations in sea level than cyclothems show from the Gondwanaland glaciation. Therefore, it is possible that isostatic change in relief of the microcontinent locally influenced relative sea level. The isostatic change could be a result of varying rates of conversion between the North China block and the Siberian craton. Periodic uplift of the microplate due to active convergence would cause relative sea level to drop. When the rate of uplift exceeded the rate of glacial melt, sea level would appear to drop. However, when the rate of uplift slowed down or periodically stopped, sea level would

appear to rise. Such a phenomenon provides a possible explanation for the numerous changes in sea level exhibited by the stratigraphy of the formation.

PALEOGEOGRAPHY

The core of Asia was assembled during many terrane accretions during the late Paleozoic to early Mesozoic (Heubeck, 2001). These terranes were located in a paleo-ocean between the converging Siberian Craton and North China Block. The microplate on which the Zuun Gashuun Formation was deposited represents one of these terranes which was accreted as the two blocks came together.

Lack of volcanic rocks in the measured section indicates that the rocks were deposited before the microplate was accreted. Although its origin is unknown, the marble suggests that the deposition took place near the equator in warm and shallow seas.

DISCUSSION

The rocks of the Zuun Gashuun Formation, previously thought to be Ordovician, are now suspected to be Carboniferous. The rocks were likely deposited during the Carboniferous in shallow, equatorial seas. The stratigraphy of the formation indicates that relative sea level was oscillating quite frequently on the low-relief microcontinent. During relative high stands, fossiliferous limestone was deposited. When relative sea level lowered, shale and sandstones were deposited.

The oscillation of sea level may have been caused by interaction between sea level changes due to glaciation and relative sea level changes due to an isostatic change in the elevation of the microplate. It is suspected that both of these processes were involved, as the stratigraphy indicates frequent sea level changes that could not be explained by merely the growth and melting of glaciers.

Little research has been done in the Tavan Har area, and more research is needed to better understand the age, depositional processes, and paleoenvironment of the Zuun Gashuun Formation. In addition, further research should be done in relating the Zuun Gashuun Formations to the other formations in what is believed to be the same terrane. The current stratigraphic column of the terrane shows other volcanic and clastic rocks as representing the Carboniferous system. In order to gain a more comprehensive understanding of the geology of this area, further research involving the whole terrane must take place.

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