High-Resolution International Correlation of the Lower Triassic in Southern Thailand Based on Integrated Stratigraphy of Ammonoids, Conodonts and Carbon Isotope

July 2021

Kittichai TONGTHERM

High-Resolution International Correlation of the Lower Triassic in Southern Thailand Based on Integrated Stratigraphy of Ammonoids, Conodonts and Carbon Isotope

A Dissertation Submitted to

the Graduate School of Life and Environmental Sciences,

The University of Tsukuba

in Partial Fulfillment of the Requirements

for the Degree of Doctor of Philosophy in Science

(Doctoral Program in Earth Evolution Sciences)

Kittichai TONGTHERM

CONTENTS

ABSTRACT

High-resolution international correlation of the marine Triassic Phukhaothong Dolomite Member of the Chaiburi Formation, which belongs to the Shan Thai Terrane or Sibumasu Block, in the Phatthalung area in southern Thailand is reported based on integrated stratigraphy of ammonoids, conodonts and carbon isotope. The 104 m+ thick Phukhaothong Dolomite Member exposed on the north side of an isolated mountain at Khao Thong consists of bedded to massive, light grey dolomite.

Ammonoids occur only in the middle to upper parts of the member, whereas conodonts are abundant throughout the sequence. Seven distinct early Spathian ammonoid assemblages, the *Columbites* sp. indet. beds, *Arctomeekoceras*? sp. indet. beds, *Tirolites* sp. indet. B beds, *Tirolites* sp. indet. C beds and *Tirolites* sp. indet. D bed in the *Tirolites-Columbites* Zone, and the *Idahocolumbites cheneyi* beds and *Idahocolumbites* sp. nov. beds in the *Idahocolumbites* Zone, as well as a late Smithian conodont zone, the *Hadrodontina aequabilis-Staeschegnathus perrii* Zone, and three early Spathian conodont zones, *Icriospathodus crassatus* Zone, *Triassospathodus symmetricus-Novispathodus anhuiensis* Zone and *Novispathodus* sp. indet. I-*Novispathodus* sp. indet. J Zone are recognized in ascending order.

A total of 104 dolomite samples were measured for carbon isotope ratio ($\delta^{13}C_{carb}$). Low $\delta^{13}C_{carb}$ value (-0.97‰) measured at the base of the section are followed by a gradual increase until highest value (+3.86‰) within the lower part of the member including the *Hadrodontina aequabilis-Staeschegnathus perrii* Zone. The values gradually decrease from +3.86 to -0.59‰ within the middle part of the member, and then gradually increase from -0.60‰ to +1.89% within the upper part of the member. The carbon cycle curve recorded in the Phukhaothong Dolomite Member corresponds to the late Smithian to early Sapthian global carbon isotope positive and following negative excursions recorded from the Tethyan, Panthalassa and Boreal regions. The Smithian-Spathian boundary is probably located between the *Hadrodontina aequabilis-Staeschegnathus perrii* and *Icriospathodus crassatus* zones.

The age of the primitive ichthyopterygian *Thaisaurus chonglakmanii* collected from the *Idahocolumbites cheneyi* beds is constrained to the early Spathian, thus suggesting it is the oldest known ichthyopterygian, because the range of *Marcouxia* and *Idahocolumbites* is limited to the *Columbites parisianus* Subzone of the lower Spathian in the western USA.

The Spathian ammonoid faunas exhibit a very strong relationship with other Tethyan as well as eastern Panthalassa faunas in the low equatorial zone, but show no relationship with fauns in the middle and higher latitudinal areas, suggesting that the faunas were differentiated in the latitude direction during the Spathian. The late Smithian to early Spathian conodont faunas also show a strong relationship with faunas in the low equatorial zone.

Most of the Chaiburi Formation is distributed as isolated mountains protruding from the Quaternary plan and consequently, it had been difficult to make detailed correlations between these isolated mountain outcrops because of the absence of key age datable horizon such as tuff beds. Discovery of ammonoid *Marcouxia chaiburiensis* at Khao Chingcho permits to correlate this section with the Khao Thong section. Because *M. chaiburiensis* is easily recognizable in the field and its occurrence is limited to a narrow stratigraphic range, this ammonoid may provide an important key for understanding the stratigraphic relationships of the Chaiburi Formation distributed throughout the isolated mountain outcrops as well as the geological structure in the Phatthalung area.

Fifty-eight taxa (ammonoids: 26, conodonts: 32) including two new ammonoid species (*Marcouxia chaiburiensis, Idahocolumbites* sp. nov.) are described.

Keywords: Ammonoids, carbon isotope, Chaiburi Formation, conodonts, Lower Triassic, Peninsular Thailand, Phatthalung, Phukhaothong Dolomite Member, Olenekian, Smithian, Spathian, stratigraphy.

LIST OF FIGURES

Pages

Pages

Pages

Pages

LIST OF APPENDIXS