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Early Silurian chitinozoans from the Qusaiba type area, North Central Saudi Arabia

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ABSTRACT

Sixty one core samples from three shallow core holes (Qusaiba-1, Baq'a-3 and Baq'a-4) penetrating the Qalibah Formation (Qusaiba Member) in the North Central Saudi Arabia were investigated. These core slabs corresponding to grey–greenish hemipelagic shale or silty-shale yield well-preserved and very abundant early Silurian chitinozoans. Most of the recorded chitinozoan assemblages are diverse and include several new species occurring with well-known species. An informal early Rhuddanian chitinozoan assemblage dominated by *Cyathochitina caputoi* is documented in the lowermost part of the Qusaiba Member. The six chitinozoan biozones defined above this basal assemblage range from Aeronian to Telychian. They are considered of regional value for northern Gondwana. From the lowest to the highest they are the *Angochitina qusaibaensis* (pro parte), *Conochitina alargada*, *Angochitina hemeri*, *Angochitina macclurei*, *Tanuchitina obtusa* and *Euconochitina silurica* biozones. The older regional biozones have been previously documented in Saudi Arabia whereas the two youngest ones, the eponymous index species of which were described from the subsurface of the Algerian Sahara, are documented for the first time in the Arabian Peninsula. Four subbiozones, of at least of regional application, are also defined in order to improve the precision of biostratigraphic correlation between Silurian lithostratigraphic units cropping out along the Arabian Shield and their counterparts in the subsurface of Central Saudi Arabia. Thanks to the closely spaced and to the regular sampling, the total range of several highly diagnostic forms as well as the interval of uncertainty between the successive chitinozoan biozones are better constrained. A hiatus with a duration of late Rhuddanian to early Aeronian separates the lowest informal chitinozoan assemblage from the *qusaibaensis* Biozone. A recent detailed study of the graptolites in the three cored holes provides independent chronostratigraphical control calibrating the previous chitinozoan-based age assignments. The *qusaibaensis* (pro parte), the *alargada*, and the *hemeri* chitinozoan biozones occur with the mid-Aeronian *convolutus* graptolite Biozone whereas the *macclurei* chitinozoan Biozone extends through the early Telychian *guerichi* and *turriculatus* graptolite biozones. The *obtusa* and the *silurica* chitinozoan biozones occur in an interval devoid of usable graptolites. They are referred to the mid–late Telychian as they do not contain typical Sheinwoodian species.

Besides the abundant chitinozoans and acritarchs, sporadic occurrences of scolecodonts and of eurypterid cuticle fragments are also noted in the organic residues. The presence of eurypterids reflects a shallowing trend in the sedimentary record, which is consistent with the distribution of the graptolite remains (siculae and/or rhabdosomes). Indeed, graptolites are common throughout the Qusaiba Member, except in the youngest processed samples presaging the shallower environments prevalent in the Sharawra Member. The taphonomy of the chitinozoans (isolated vesicles, chain-like structures, clusters, coprolites) and their environmental context is briefly discussed.

Fifteen new species are described and illustrated: *Ancyrochitina alhajrii* sp. nov., *Ancyrochitina camilleae* sp. nov., *Armoricochitina crassicarinata* sp. nov., *Armoricochitina gengi* sp. nov., *Bursachitina baqaensis* sp. nov., *Conochitina viiuae* sp. nov., *Cutichitina minivelata* sp. nov., *Cyathochitina neolatipatagium* sp. nov., *Fungochitina merrelli* sp. nov., *Muscochitina olivieri* sp. nov., *Plectochitina alisawyiahensis* sp. nov., *Plectochitina alnaimi* sp. nov., *Plectochitina jaquelineae* sp. nov., *Plectochitina lucasi* sp. nov., and *Spinachitina geerti* sp. nov.

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1. Introduction

Under the auspices of the Commission Internationale pour l'étude de la Microflore du Paléozoïque (CIMP) a multi-disciplinary project with Saudi Aramco was initiated in the early 1990s for documenting organic-walled microfossils and biostratigraphy from the Ordovician and Silurian formations from Saudi Arabia. One of the goals was to develop a robust regional chitinozoan biozonation allowing correlation between the strata exposed along the margin of the Arabian Shield and the Early Palaeozoic units including source rocks and reservoirs buried beneath a Mesozoic and Cenozoic cover in central and southern Saudi Arabia (Fig. 1a). The first step is to establish and calibrate the chitinozoan biozones from the type areas of the Ordovician and Silurian formations and members exposed in the north-western part of Central Saudi Arabia. In Saudi Arabia, as in most of the tropical and sub-tropical desert regions, deep surficial weathering affects much of the exposed sedimentary rocks. This weathering proved to be responsible for the partial to total destruction of organic-walled microfossils and of the amorphous organic matter. In order to overcome this weathering phenomenon, shallow cores were drilled in the type area of the Qusaiba Member of the Qalibah Formation. They have been sampled and studied for the chitinozoans and other organic-walled microfossils (see this volume).

As far as chitinozoans are concerned, the Qalibah Formation is the most extensively investigated among the Saudi Arabian Early Palaeozoic lithostratigraphic units. The data are available in the following papers (McClure, 1988; Aoudeh and Al-Hajri, 1995; Paris and Al-Hajri, 1995; Paris et al., 1995; Al-Hajri and Paris, 1998; Paris et al., 2008) as well as an unpublished thesis (Al-Hajri, 1991) and numerous Saudi Aramco internal reports (more than 300 internal reports). The goal of the present study is to refine the northern Gondwana chitinozoan biozonation based on the Saudi Arabian collections with the introduction of new biozones and subbiozones applicable to the Arabian palaeoplate. Graptolites present in part of the section investigated (Zalasiewicz et al.,

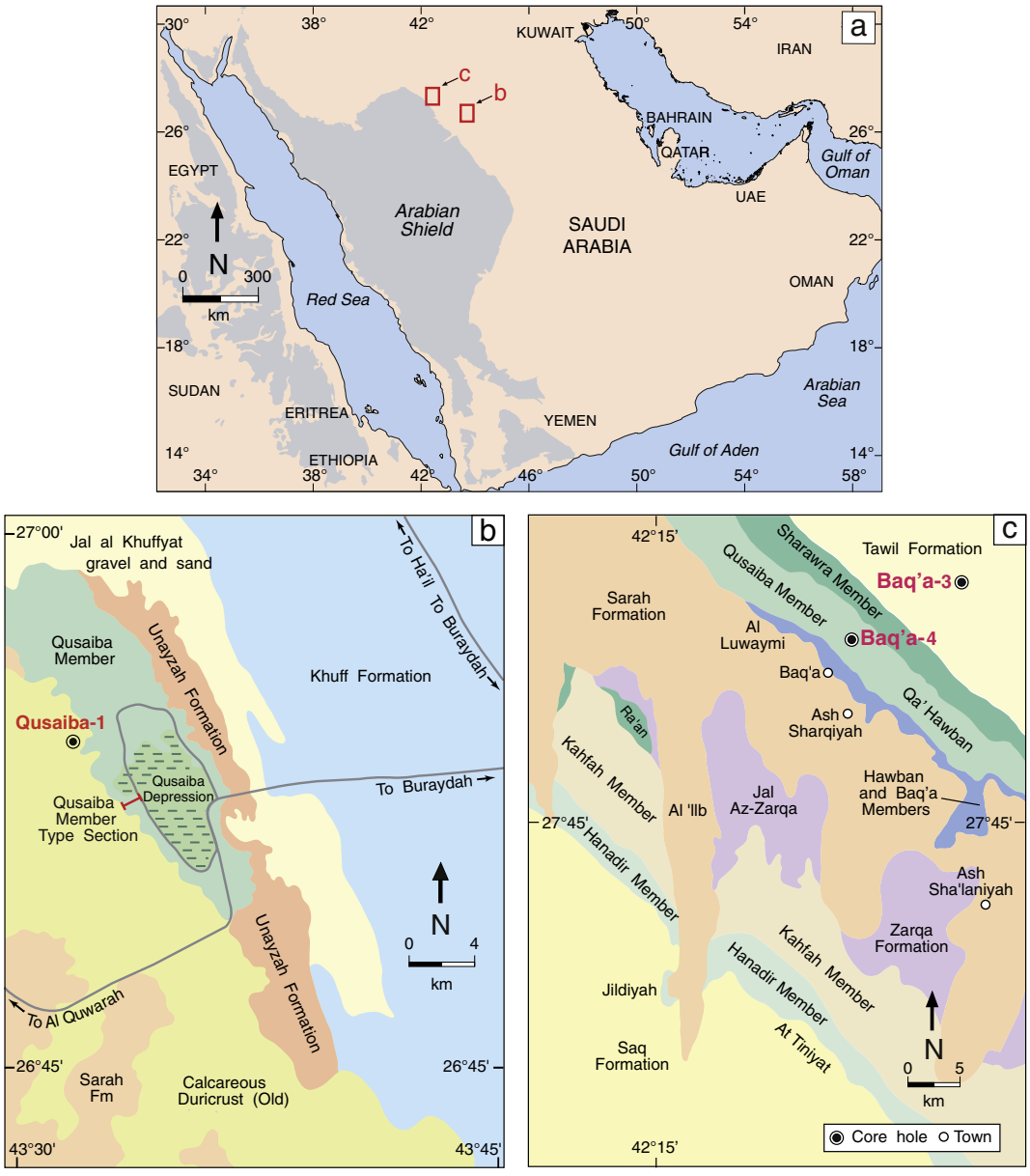

Fig. 1. a–c. Location map showing the study areas in Saudi Arabia (1a) and the position of the previously studied wells. (1b) location of the Qusaiba-1 core hole, (1c) location of the Baq'a-3 and Baq'a-4 core holes (modified from Zalasiewicz et al., 2007).