

## FOUR PALEONTOLOGICAL SITES NEAR THE SINAIA CITY – SUGGESTIONS FOR PROTECTION AND ECOTOURISM USE

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**Abstract.** The Sinaia Formation sedimentary deposits are abundant in fossils that are important not only for Romania, but also for international paleontological correlations and interpretation. Four fossil abundant sites placed in the area of the Bucegi Natural Park are considered in this paper: one of them is an already declared Geological and Biological Monument (Sfânta Ana). The outcrops have been studied in the past, but a thorough and integrated research has not been carried out. Also, they are not yet mentioned as paleontological sites in the Bucegi Natural Park Integrated Management Plan and we propose that a more careful attention should be attributed to this natural monuments and some minimal setup for tourism.

**Keywords:** paleontological site, Sinaia, ecotourism.

**Rezumat. Patru situri paleontologice lângă orașul Sinaia - Sugestii pentru protecție și utilizare eco-turistică.** Partea superioară a depozitelor sedimentare din zona Sinaia abundă în fosile care sunt importante nu numai pentru România, ci și pentru corelațiile și interpretările paleontologice internaționale. În această lucrare sunt luate în considerație patru situri paleontologice abundente în fosile plasate în zona Parcului Natural Bucegi, unul dintre ele este deja declarat Monument Geologic și Biologic (Sfânta Ana). Aflorimentele au fost studiate în trecut, dar nu a fost efectuată o cercetare aprofundată și integrată. De asemenea, acestea nu sunt încă menționate ca situri paleontologice în Planul Integrat de Management al Parcului Natural Bucegi și propunem să se acorde o mai mare atenție acestor monumente naturale și o minimă amenajare pentru turism.

**Cuvinte cheie:** situri paleontologice, Sinaia, ecoturism.



Figure 1. The map location of the proposed paleontological sites: 1 - “Stânca Piticului”, 2 - The Olistolith from the Peleş Valley, 3 - Sf. Ana, 4 - Stânca Izvor - Valea Zgarburei (Google Maps, 2017 with additions).

### INTRODUCTION

West from Sinaia, just after the city limits, lies the Bucegi Natural Park founded by Ministry Order 7/27.01.1990 and reconfirmed by the law no. 5/2000, a complex protected area (STANCIU & FLORESCU, 2009). In this region (as seen in Fig. 1) there are 4 paleontological sites of a big scientific interest and also, they can become of interest for the tourists but only with some precautions and regulations.

The first paleontological site, “Stânca Piticului” is located just at the limit of the Natural Park with the Sinaia City, in the durable management area (Planul de Management Integrat al Parcului Natural Bucegi și al Sitului Natura 2000 ROSCI 0013, 2017, 2017); is placed right beside a private property. The second site, known as The Olistolith from the Peleş Valley (PATRULIUS, 1969) is placed in the maximum protection area of the Bucegi Natural Park. The third one, Sfânta Ana is between the two protection areas: maximum protection and durable management. “Stânca Izvor” – Zgarburei Valley, the last paleontological site proposed in this paper is located in the durable management area due to the vicinity to the communal road 134 (the way to Cota 1400).

Regarding the geological setting, the area of interest is part of the Sinaia Formation of Barremian - Aptian age. The Sinaia Formation is up to 2500 m thick and consists mainly of flysch represented by carbonate-rich siliciclastic and thick sedimentary deposits. The stratigraphy of the area has been studied by many authors starting with POPOVICI-HAȚEG (1898), PROTESCU (1936), ONCESCU (1965), PATRULIUS (1953, 1954, 1959, 1964, 1966, 1969 and 1970), MURGEANU & PATRULIUS (1957) and others. The sites have been

described in detail by PATRULIUS (1969, 1970). They have even been marked on the geological map 1:50,000 of Bucegi Masive and Dâmbovicioara Couloir (PATRULIUS, 1969). Recent researches related to the general geological context and stratigraphy have subsequently been made and new data and theories are emerging: BARBU & LAZĂR (2010), SANDY et al. (2012).

## SITES DESCRIPTION

The limestones around Sinaia are consisting in 3 types of imposing facies (Furnica, Sf. Ana, Piatra Arsă), of more than one kilometer long as klippen, and some other smaller ones as blocks/cliffs. Until 1952 this limestones were considered to be of Tithonian – Berriasian age (POPOVICI – HATZEG, 1897 and ONCESCU, 1934 in PATRULIUS, 1969) or only Tithonian (JEKELIUS, 1938 in PATRULIUS, 1969). PATRULIUS (1969) says that the facies of Piatra Arsă and its subordinated type of limestones is the most abundant in macro - fossils.

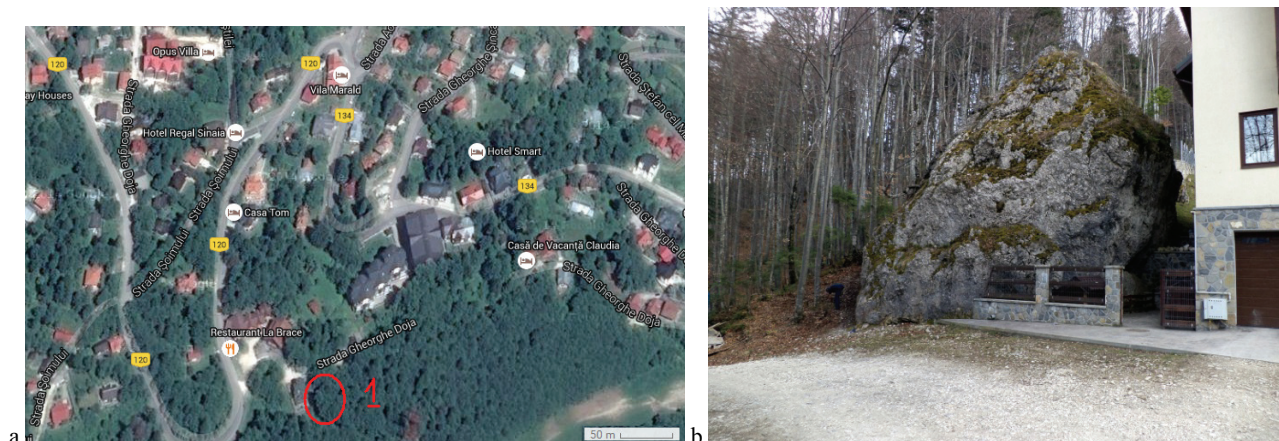


Figure 2. The paleontological site named “Stâncă Piticului”: a. map location of the site (Google Maps, 2016 with additions); b. the outcrop and the private property next to it (original).

The first point of interest named “Stâncă Piticului” (see Figs. 2a, b) was considered a geological monument (PATRULIUS, 1969) but the new law (no. 5/2000) didn't take regard of it. In 2010 a new private construction was build right next to it.

The outcrop (Fig. 2b) represents a limestone block with circa 7 meters height, 8 meters width and 40 meters length, situated near Gheorghe Doja (current name) street and the secondary road which climbs to Cota 1400 – Sinaia, just at the limit of the town with the Natural Park Bucegi.

Near the intersection of Furnica Street and Coștila Street, PATRULIUS (1969, 1970) mentions a fossil bearing limestone. It is an Upper Jurassic - Lower Cretaceous (150 -140 m.y.) reef limestone with a rich fossil fauna comprised of corals, sponges, bryozoans, gastropods, bivalves, cephalopods (nautilus, ammonites), echinoids, crabs (the most impressive collection in the world with the biggest number of identified species), and last but not least, *Protocypraea tithonia* Gemmellaro, as first representatives of Cyprinidae. In the National Geological Museum's Paleontological Collection there are more than 1500 fossils from this site (Fig. 3).

This small block of reef limestone might be the most rich in fossils to be documented in the Romanian Carpathians, for its age – Tithonian; here were described more than 200 fossil species: cephalopods (17), brachiopods (10), bivalves (80), gastropods (60), echinoids (7), crabs (40), corals and sponges; this block is *locus typicus* for many species which have been discovered and described by PATRULIUS (1959, 1964, 1966, 1969). This site has a scientific importance of the first category according to the IUCN classification (see conclusions).

The second paleontological site is found on the protected territory of the Bucegi Natural Park, near another objective – The Stone of Saint Ana/Stâncă Sfânta Ana - on the road that goes up to the Poiana Stâni Regale, which departs from the road that goes to Cota 1400. Part of the site is right near the roadside, at the first serpentine, and continues on the path that crosses the Peleş Valley and climbs to the Poiana Stâni Regale. The eastern part of the site is comprised of sandstones, marls and jaspers and the western part of nodular limestones. The site is larger than the first one, approximately 350 meters in length and 50 meters in height.

PATRULIUS (1970) noted that the course of Peleş River passes through a block of limestone. At the bottom of that limestone he observed some red jasper that in thin sections proved the presence of Oxfordian radiolarians. The fossil content of all the deposits from this olistolith is scarce, but of stratigraphic and tectonic importance. It is one of the rare occurrences of Callovian age in our country, with fossiliferous beds representing a small interval of geological time. The site can be further studied and potentially new fossil species can be found here for Callovian – Kimmeridgian interval. It also has a paleogeographic importance for this interval that might prove very important for the tectonic evolution of this region.



Figure 3. Images of the D. Patrușiu Collection (from the collections of the National Museum of Geology, Bucharest) from the “Stâncă Piticului” and Sfanta Ana olistolith – Upper Jurassic rocks in this perimeter of Sinaia: a, d - ammonites, b, c, e, f, g – bivalves, e – brachiopods, h, i, j – gastropods, k – crabs (original).

The limestone olistolith from the Peleş Valley displays significant faults (Figs. 4a, b) and many limestone pieces can be found on the ground, detached from the olistolith. These smaller blocks have fossils and their collection without authorization from the responsible authorities of the Bucegi Natural Park is forbidden, as stated, in a general way (without a punctual reference), in the Integrated Management Plan of the Bucegi Natural Park (R. N. Pad. Romsilva, Adm. Bucegi Natural Park, 2017). The erosion degree in the Sinaia area is medium (COCEAN et al., 2010).



Figure 4. a - The limestone olistolith from the Peleş Valley with erosion signs, most important is a quasivertical fault of approximately 6 m (original); b - *Macrocephalites* sp. found near the olistolith, in grey slates (original).

The third site, Sfânta Ana olistolith (Fig. 5a), is constituted by Middle-Upper Jurassic siliciclastic and carbonate deposits with ammonites, belemnites, bivalves, echinoids, rare brachiopods and radiolarians (BECCARO & LAZĂR, 2007) (Fig. 3). Compared to the other three sites described, it is the poorest in fossils, but until present times no studies on the higher part of the site's walls have been conducted. They are possible but only by climbing routes. The site has been known since the early 19th century. It is more of a historical and geomorphologic site, but the paleontological value can't be overviewed. The exposure of the limestone in the site is very large, including the Valley of St. Ana with waterfalls; the width appraised at 400 m with a height of the walls of 60-80 m.

The fourth site, "Stânca Izvor" –Zgarburei Valley (Fig. 5b) is part of a set of rocks embedded in a limestone breccia matrix with stratiform extension in the slopes of Zgarbura Valley. This olistolith is located in a bend of the communal road 134, which goes to Cota 1400, near Davila's Spring Fountain; the marked tourist path passes right beside it, therefore it can be easily accessed by tourists. The olistolith has a height of approximately 10 m and it extends over 200 m in length. The reddish limestone of this olistolith has a fossil content that certifies the age of the Kimmeridgian - Tithonian. The fossil fauna is represented mainly by ammonites and brachiopods and rare bivalves. The limestone also contains a microfauna studied by PROTESCU (1936) and PATRULIUS (1969).



Figure 5. a - Stânca Sfânta Ana – panoramic view, in the middle can be seen an old hermitage build in 1453 (MĂGUREANU, 2000) (Photo credit to Radu Lipșa); b - "Stânca Izvor" – Zgarburei Valley, sight from the main road, the outcrop has vegetation cover (Google Maps, 2017).

## CONCLUSIONS

From these paleontological sites originate more than 3000 specimens of various Jurassic fossils, among which the most famous collection of fossil crabs in the world and 3 specimens out of 4 from *Protocypraea thithonia*, Gemmellaro known in the world (see Fig. 3k). The scientific value of the "Stânca Piticului" site is significant; it might be included in the UNESCO Heritage.

Legislation regarding the paleontological and geological protected areas is assured by the law no. 5 from March 6, 2000 regarding the approval of The National Territory Planning Plan – Section III, protected areas, Government Emergency Ordinance no. 57/2007 on the regime of natural protected areas, conservation of natural habitats, wild flora and fauna, approved with amendments and completions by Law no. 49/201. A newer consideration must be taken and the first step for it, regarding that we are in a National Park area is to address to the National Agency for Environmental Protection to assign administration (Article 18, paragraph 4 of Law no. 49/2011).

Ecotourism can be considered the most suitable way of conservation and exploitation of these places. That means more than tourism in nature, is a form of tourism with a double exigency: the development of local tourism and the long-term nature protection. Ecotourism is based on nature conservation and has an educational character (for tourists but also for the local community), implies a responsibility of tourists and produces minimal impact on the environment. It's recommended that the tourists should benefit from professional guidance. These principles should be applied to all four proposed sites.

The sites can be arranged as a touristic local circuit, also, the non-consolidated paleontological material (loose fossils) can be arranged in situ as a Paleontological Collection for a better understanding of the taxonomy or it can be used as an exhibition for the local museum in Sinaia.

The most important thing is the signage of the sites (with route indicators and placement of indicator plates at the paleontological site (\*\*\*) *Ghid pentru dezvoltarea unei destinații de ecoturism*) and a minimal surveillance to prevent the damages. Also, after the scientific documentation, a printed material for the tourists can be distributed into the informative points along Prahova Valley.

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