

$^{40}\text{Ar}/^{39}\text{Ar}$ Dating of Tuffs from the North Croatian Basin

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North Croatian Basin (NCB) is located in the Central and Eastern Croatia and represents a south-western part of the Pannonian Basin System. The formation of the NCB commenced 18 million years (Ma) ago and is still lasting today. In this period, except the period of Middle Miocene when it was a part of the Paratethys sea, NCB represented an isolated basin characterized by alluvial, fresh-water and brackish lake deposition (RÖGL, 1996; PAVELIĆ, 2001; PAVELIĆ & KOVAČIĆ, 2018). These periods were characterized by the evolution of endemic species which make the correlation of the beds from the NCB with the beds from the surrounding basins difficult (HARZHAUSER & PILLER, 2007). The most intensive period of volcanic activity was during the Karpatian and the Early and Middle Badenian. Karpatian and Early to Middle Badenian ages are marked by the numerous layers of tuff in the investigated area (PAMIĆ, 1997). Although layers of tuff represent a potential stratigraphic marker, especially in non-marine sediments they haven't been used for this purpose in the NCB. The aim of this research is the reconstruction of the time frame of the evolution of NCB based on the $^{40}\text{Ar}/^{39}\text{Ar}$ dating of the tuffs from different localities and different stratigraphic levels.

Facies analysis and the determined fossil assemblage found in sediments of the investigated area point to fresh-water, brackish and marine depositional environment. The palynomorph assemblages imply that the deposition took place in a moderate to subtropical climate. According to the results of the $^{40}\text{Ar}/^{39}\text{Ar}$ dating on sanidine, tuffs have been dated in the range from 17 Ma to 14.4 Ma (Table 1).

The fossil assemblage of foraminifera, ostracods, nanoplankton and palynomorphs shows that the tuffs older than 15.1 Ma were deposited in freshwater or brackish lake environments, while those dated as 14.8 to 14.4 Ma old were deposited in marine environments.

Formation of the NCB started in Ottnangian with the deposition of coarse grained sediments, dominantly conglomerates intercalated with layers of tuffs in the Kalnik area which have been dated at 18 Ma (MANDIĆ et al., 2012). Alluvial environments have been gradually replaced with freshwater lake environments. This type of environments lasted up to 15 Ma ago. Layers of tuff found within freshwater lake sediments at the sites of Sjeniĉak and Paripovac in Banovina area, whose age is determined at approximately 16 Ma (MANDIĆ et al., 2012) and the tuff determined in the same area at Jovac locality with a determined age of 15.1 Ma confirm that claim. The existence of the freshwater lake environment, with possible marine influences, was also revealed at the locality of Laz on Medvednica Mt. where the age of the tuff was determined at 15.4 Ma. The layers of tuff found within the marine sediments have an age of 14.8 Ma, at the locality of Ćučerje-1 on Medvednica Mt. and 14.4 Ma on the locality of Nježiĉ in Slavonija. The mentioned results indicate that the marine transgression in the area of the North Croatian Basin took place around 15 Ma ago, while according to the previous studies (PAVELIĆ, 2001) it was supposed to have started at the beginning of the Karpatian.

Keywords: $^{40}\text{Ar}/^{39}\text{Ar}$ dating, Miocene, North Croatian Basin, tuffs

Table 1. $^{40}\text{Ar}/^{39}\text{Ar}$ dating results (Values marked with [*] are from (MANDIĆ et al., 2012). MSWD – Mean Square Weighted Deviation.

Locality	Environment	Age (Ma)	Deviation [s] (1σ) (Ma)	Nr. of analysis	MSWD
Nježiĉ	Marine	14.40	± 0.03	3/10	2.08
Ćučerje-1	Marine	14.81	± 0.08	4/10	1.45
Jovac	Fresh-water	15.10	± 0.06	4/10	0.96
Laz	Fresh-water/brackish	15.42	± 0.15	12/20	1.64
Sjeniĉak*	Fresh-water	15.91	± 0.06	5/10	1.18
Paripovac*	Fresh-water	16.03	± 0.06	6/9	2.04
Lonĉarski vis	Unkown	16,96	± 0.03	19/20	2.34

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Latest Maastrichtian to Earliest Palaeocene Platform Carbonates With Coral-Stromatoporoid Patch Reefs, the Island of Brač (Croatia)

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Deposits comprising the Cretaceous–Palaeogene (K/Pg) transition reveal evidence of biotic crisis and one of the most severe global mass extinctions. Studied uppermost Maastrichtian–lowermost Palaeocene (Danian) section on the NW part of the Island of Brač (Likva Cove) comprises shallow marine platform carbonates with continuous K/Pg transition and exceptionally well preserved *in situ* scleractinian coral and stromatoporoid patch reefs.

The Cretaceous part of the section is characterized by co-occurrence of rudists and corals: micritic limestones with rudist and echinoid fragments, ostracods, small benthic foraminifera (discorbids, *Rhapydionina* sp., *Dicyclina* cf. *schlumbergeri*, *Monchardmontia apenninica*, *Laffiteina* sp., *Fleuryana adriatica*) alternate with scleractinian coral and stromatoporoid reef levels, which are poor in other fossil remains. Immediately below the K/Pg boundary, which is already defined by other researchers, last rudists and a concentration of small benthic foraminifera (mostly miliolids) occur. Oldest Palaeocene strata record the input of planktonic foraminifera in otherwise shallow marine micrites with discorbids. The rest of the Palaeocene comprises micrites with ostracods, discorbids, occasional charophyta and *Bangiana hanseni*, which are overlain by the best exposed and biggest patch reef.

Cretaceous and Palaeocene strata show certain differences – shallow marine restricted environments with rudist and bioclastic micrites and tidal flats with laminated fenestral limestones prevail in the Cretaceous, while Palaeocene deposits are characterized by a very shallow restricted marginal marine and freshwater to brackish environments with ostracod-discorbid micrites with charophyta. However,

Cretaceous and Palaeocene reef levels are very similar, albeit almost identical. A 50-m-thick succession contains three well-marked and several less prominent reef levels in the Cretaceous part and at the top of the section the most pronounced a single Palaeocene reef level occurs. All four main reef levels formed on top of clear subaerial emersion surfaces indicating that corals and stromatoporoids preferred colonization of hard substrates. Scleractinian corals are present with globular and domal growth forms forming small (up to 2 m in diameter) coral knobs, which formed low relief above the surrounding bottom. Generic determination of corals was not possible due to the intense recrystallization, but they resemble recent finger-like coral colonies such as *Porites* sp. Massive domal and bulbous stromatoporoids occur together with corals, but also individually within the youngest reef level. Wavy-laminar stromatoporoids usually overgrow/encrust(?) coral colonies. Recrystallized micrite, occasionally with very rare ostracods and discorbids, fills the spaces between the knobs. It occurs also as internal sediment partly filling the reef cavities within the youngest reef level, while the rest of the cavities are often filled by botryoidal calcite crystals.

Well-developed coral and stromatoporoid patch reef in the earliest Palaeocene suggests that recovery of reefs was rapid and early, already during the Danian.

Acknowledgements

This research is supported by the Croatian Science Foundation (IP-2014-09-9541).

Keywords: Cretaceous–Palaeogene (K/Pg) transition, corals, stromatoporoids, Brač, Croatia