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Discovery of Triassic-age detrital zircons in Keuper continental deposits: age of Lisowice bone-bearing horizon (Poland)

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Researchers often face the problem of precise and trustworthy dating of terrestrial bone-bearing horizons. If such the horizons occur within sedimentary basins located adjacent to convergent plate margins, where zircon-bearing volcanic ashes were supplied, U-Pb geochronology can be easily involved to determine their ages. However, in cases of intracratonic settings the youngest zircons can be overshadowed by older populations. The Lisowice vertebrate hard-part-bearing horizon is one of such the cases. This horizon, cropping out of the Lipie Śląskie clay-pit (Upper Silesia, Poland) is one of the most famous Keuper Lagerstätte. The horizon has yielded numerous remains of giant dicynodonts and other reptiles, which are of great value in answering evolutionary questions. However, the depositional age of the bone-bearing horizon is still controversial and proposed ages range from the early Norian to early Rhaetian (Late Triassic). None of the non-geochronological methods used gave a clear and unequivocal results. The recent discovery of several Triassic-age detrital zircons in the lower interval of this horizon allows us to contribute to this discussion. The main aims of this study were to determine the maximum age of deposition of the Lisowice bone-bearing horizon using the youngest single-grain age, and to identify source rocks for the Triassic-age pyroclastic zircons. The three zircons yielded SHRIMP U-Pb ages ($\pm 10\%$ discordant) of 211 ± 3 Ma, 222 ± 2 Ma, and 230 ± 2 Ma along with 237 ± 3 Ma. The Triassic-age zircons are pyroclastic constituents, likely supplied from volcanic eruptions that occurred on the southern margin of the Eurasia plate. At least two factors could affect the estimated maximum depositional age of the Lisowice horizon. The youngest zircon crystallized in a magma chamber an unknown time before a volcanic eruption. The length of time between the ash fallout and the final burial of the youngest zircon grain is also impossible to determine. That means that the Lisowice bone-bearing horizon must have originated later than it is suggested by the crystallization age of the (likely redeposited) youngest pyroclastic zircon (211 ± 3 Ma). Another problem that must be addressed with determining of exact ages of Late Triassic sites is the lack of clearly defined stage boundary numerical ages. Thus, if the Norian–Rhaetian boundary age were to be taken as ~ 205.5 Ma and the Alaiunian–Sevatian boundary were taken as ~ 209 – 210 Ma, then the age of the youngest zircon examined here, which falls within the 208 – 214 Ma range (211 ± 3 Ma), would point to the middle Norian as the maximum depositional age. If the Norian–Rhaetian boundary age were to be taken as ~ 205.5 Ma, but the Alaiunian–Sevatian boundary were taken to be ~ 214 – 216 Ma, then the age of the youngest zircon would point to the late Norian as the maximum depositional age. This first discovery of Triassic-age detrital zircons in the continental Keuper Group succession of the Central European Basin show that searching for detrital zircons that are useful for absolute dating of intracratonic-located bone-bearing horizons can be successful. The research was financed from NCN grant 2014/13/B/ST10/02102.

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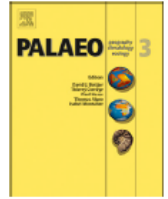
Palaeogeography, Palaeoclimatology, Palaeoecology 514 (2019) 487–501



Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

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The youngest detrital zircons from the Upper Triassic Lipie Śląskie (Lisowice) continental deposits (Poland): Implications for the maximum depositional age of the Lisowice bone-bearing horizon



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ARTICLE INFO

Keywords:

Keuper
Sevatian
Norian
Rhaetian
Upper Silesia
Vertebrate

ABSTRACT

The Lisowice vertebrate hard-part-bearing horizon, cropping out of the Lipie Śląskie clay-pit, is one of the most famous Keuper Lagerstätte (Upper Silesia, Poland, Europe). The horizon has yielded numerous remains of rhino-size dicynodonts and other reptiles. However, the depositional age of the bone-bearing horizon is still controversial and proposed ages range from the early Norian to early Rhaetian (Late Triassic). The recent discovery of Triassic-age detrital zircons in the lower interval of this horizon allows us to contribute to this discussion. The main aims of this study were to determine the maximum age of deposition of the Lisowice bone-bearing horizon using the youngest single-grain age, and to identify source rocks for the Triassic-age pyroclastic zircons. The three zircons yielded SHRIMP U-Pb ages ($< \pm 10\%$ discordant) of 211 ± 3 Ma, 222 ± 2 Ma, and 230 ± 2 Ma along with 237 ± 3 Ma. The Triassic-age zircons are pyroclastic constituents, likely supplied from volcanic eruptions that occurred on the southern margin of the Eurasia plate. At least two factors could affect the estimated maximum depositional age of the Lisowice bone-bearing horizon. The youngest zircon crystallized in a magma chamber an unknown time before a volcanic eruption. The length of time between the ash fallout and the final burial of the youngest zircon grain is also impossible to determine. That means that the Lisowice bone-bearing horizon must have originated later than it is suggested by the crystallization age of the (likely re-deposited) youngest pyroclastic zircon (211 ± 3 Ma). If the Norian–Rhaetian boundary age were to be taken as ~ 205.5 Ma and the Alaunian–Sevatian boundary were taken as ~ 209 – 210 Ma, then the age of the youngest zircon examined here, which falls within the 208–214 Ma range (211 ± 3 Ma), would point to the middle Norian as the maximum depositional age. If the Norian–Rhaetian boundary age were to be taken as ~ 205.5 Ma, but the Alaunian–Sevatian boundary were taken to be ~ 214 – 216 Ma, then the age of the youngest zircon would point to the late Norian as the maximum depositional age.