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The Discovery and Significance of Permian Subducting Oceanic Crust on the Eastern Margin of Jiamusi Massif, NE China

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Abstract: The researched region is located in the eastern Heilongjiang Province, NE China, bordering with Russia across Heilongjiang and Wusulijiang rivers. The area is divided into two tectonic units, namely the Jiamusi Massif and the Nadanhada Mesozoic complex, bounded by the NNE spreading Tongjiang - Mishan fault. As the Jiamusi Massif, which is composed of Pre-Mesozoic geological bodies, is situated in the most eastern margin of the Central Asian Origenic Belt, and the Nadanhada Mesozoic complex is located at the most western margin of the Western Pacific, its tectonic significance has always been the concern of the people. In this paper, we select the east subduction complex of the Jiamusi Massif and siliceous rocks of the Nadanhada Mesozoic complex as the research target. Samples, from Tongjiang - Qindeli, Hongqiling - Shichang, and Hamotong - Yuejinshan – Dongfanghong, were considered to be the part of Mesozoic complex. Based on the geochronological data of the Permian volcanic rocks and granites in the eastern margin of Jiamusi massif, the tectonic evolution history of the Jiamusi massif and the Nadanhada Mesozoic complex, are discussed.

LA-ICP-MS zircon U-Pb dating shows the basalts and meta-basalts in the eastern margin of the Jiamusi Massif were formed in the Permian (278-257 Ma). The geochemical analyses show that the overall geochemical composition of the basalts is basically similar. Some of the samples have E-MORB characteristics, and some are similar to N-MORB. The occipital structures of these basalts are well preserved and closely associated with siliceous rocks, mudstones and marble, indicating that this is a set of rock assemblages with oceanic crust characteristics.

A set of conglomerate with a thickness of more than 10m is found in the Shichang area. The conglomerate is mainly composed of basalt and a small amount of siliceous rock, and the kelly green siltstone is integrated over the conglomerate. The dating results show that the zircon age of basalt gravel is 268-252 Ma. We found that the data of detrital zircon in conglomerate cement and siltstone are basically the same as 216-232 Ma, 269-250 Ma, 522-494 Ma and > 800 Ma, respectively. The former is the minimum age group. Although the origin of these zircon is not yet clear, the minimum age of this group can be considered as the lower limit of the sedimentary age of this conglomerate - siltstone, that is, after the Middle Triassic. And the latter two groups are common in the Jiamusi massif. These evidences fully indicate that the sediments of the conglomerate and siltstone are mainly derived from Permian basalts and the metamorphic crystalline basement of the Jiamusi massif, and the sedimentary age should be after the Permian period. The sedimentary age of this conglomerate and siltstone is quite similar to the upper Triassic Nanshuangyashan Formation widely distributed in the area. There are banded siliceous rocks closely associated with Permian basalts in the Qindeli and Shichang areas. Discrimination diagrams of rock mineral assemblage, major and trace elements show that these siliceous rocks are formed in the continental margin environment, rather than deep-sea sediments. What's more, some siliceous rocks contain different amounts of detrital zircon, which further support their formation in the continental margin environment.

The research evidences fully indicate that the ocean ridge expansion in the Permian period (278-257Ma) in the east of Jiamusi massif. At the same time, there existed the westward subduction and accreting of oceanic crust exists on the eastern margin of the block. This progress not only provides a direct geological evidence for the rational explanation of the cause of the the Permian magma arc, but also further proves that the Nadanhada Mesozoic complex is not only composed of Mesozoic complex rocks. The Late Triassic conglomerate - siltstone is unconformable on the Jiamusi Massif and Permian basalts. The age of the detrital zircon shows that the source of the sediment mainly comes from the Jiamusi Massif and Permian basalts. These evidences fully indicate that the subduction complex of the Permian oceanic crust has become a component of the eastern margin of Jiamusi Massif before the Late Triassic. In view of the absence of Early - Middle Triassic deposits on the eastern margin of the Jiamusi Massif, it is indicated that the subduction proliferation was stopped at the time and was in the stage of tectonic uplift and erosion, and it turned into a passive

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continental margin sedimentary environment in Late Triassic. According to the structural deformation patterns and deep geophysical evidence, the Mesozoic complex is composed of a series of rocks that have been thrust to the west, which is characterized by the chevron fold structure in the siliceous rock distributed in the west of the complex. The MT profile shows that the Mesozoic complex, characterized by high resistance, has a thickness less than 2km, and a low angle electrical interface inclined to the east of Jiamusi Massif. It shows that the Permian subduction accretion complex is covered by the late thrust rock, and the three emersions are "structural windows" formed by later denudation. The latest fossil age of the Mesozoic complex and the latest age of the pillow basalt (167 Ma) are Middle Jurassic, indicating that the thrusting structure occurred after the Middle Jurassic, and that the region was located in the area of the paleo oceanic plate during the 127-85 Ma period. It occurred in the later Early Cretaceous to the earlier Late Cretaceous.

Key words: Jiamusi Massif, Permian accretion complex, Nadanhada Mesozoic complex, tectonic evolution

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