GUO Zhaojie, CHEN Shi and ZHANG Yuanyuan, 2017. The Ophiolitic Mélanges in Strike-slip Fault Zones in West Junggar, Xinjiang, NW China. *Acta Geologica Sinica* (English Edition), 91(supp. 1): 13-14.

The Ophiolitic Mélanges in Strike-slip Fault Zones in West Junggar, Xinjiang, NW China

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1 Abstract

The West Junggar region of western China, located in the far eastern end of the Kazakhstan orocline, occupies the junction of the Siberia, Tarim and Kazakhstan blocks, which is crucial for palinspastic reconstruction of the CAOB. The principal rock assemblages in West Junggar include Paleozoic ophiolitic mélanges and a thick, undeformed Upper Devonian–Lower Carboniferous sedimentary succession as the boundary of the mélanges, both of which are intruded by sub-circular Upper Carboniferous granitoid plutons and intermediate-basic-mafic dykes. On the basis of the sedimentary structures like cross bedding and convolute bedding and the geochronology data, the Upper Devonian–Lower Carboniferous sedimentary successions were identified as the Tailegula, Baogutu, and Xibeikulasi formations from the bottom up, which is an apparent shallowing-upwards ocean basin fill succession, from radiolarian cherts through 2000 meters of flysch to a more neritic Baogutu Formation to a fluvial Xibeikulasi Formation. At the bottom of the Tailegula Formation there is a peperite-bearing unit: a succession of extrusive mafic rock, mainly basaltic lava, with interbeds or blocks of sedimentary rocks including carbonate, radiolarian chert, calcareous siltstone and minor fine-grained tuffaceous sandstone. Peperites in the Tailegula are thickest and best developed as the type section. Four types of peperites were identified based on of the volcanic clast shapes and sediment-matrix properties in Tailegula: (1) arbonate-sediment-hosted fluidal peperites, (2) sandstone-hosted fluidal peperites, (3) tuff-hosted mixed fluidal and blocky peperites and (4) carbonate-sediment- hosted blocky peperites. Zircon LA-ICP-MS U-Pb dating of a tuff lens enclosed by lava showed that the peperites formed in the Late Devonian (ca. 364 Ma). The widespread peperite-bearing succession in the Tailegula Formation is of variable thickness at different sites in West Junggar, such as the Tailegula, Baijiantan, Kalaxiuka, Saertuohai, Dagun, west of the Akebastaw granite and Shinaizha areas. The peperite-bearing unit is generally undeformed in contrast to the highly deformed slices of ophiolite, and is continuously distributed as a stratigraphic section regionally on either side of the Darbut and Baijiantan ophiolitic belts. It can be taken as a mark layer to demonstrate the existence of a shallow remnant ocean basin from the end of Devonian in West Junggar, which is an important component of oceanic crust in the remnant ocean basin. Peperite, underlying Devonian or earlier oceanic crust developed in the spreading process of the ocean basin, and overlying Carboniferous remnant ocean basin-fill succession constitute the complete evolution sequence of the remnant ocean basin. The Darbut and Baijiantan ophiolitic belts should not be interpreted as significant plate boundaries and represent the underlying ocean crust uplifted along tectonic lineaments within a continuous shallow remnant ocean basin.

The Baijiantan and Darbut ophiolites are both steep fault zones (>70°) of serpentinite mélange, in contact on either side with regionally distributed and undeformed Upper Devonian–Lower Carboniferous ocean-floor peperitic basalts and overlying sedimentary successions. Ultramafic rocks is serpentinized and foliated to form the matrix of mélange. Some small blocks of peridotite are mylonitic and strongly foliated. Blocks of gabbro generally underwent prehnitization, epidotization and chloritization and many are metasomatized to rodingite. Pods of medium to fine grained amphibolites are encased in serpentinite and display relict gabbroic textures and amphibolite-facies assemblages. The Baijiantan ophiolitic mélange also includes amphibolite breccias consisting of centimeter-sized mylonitic amphibolite clasts embedded within a serpentinite matrix. Basalt lavas cropping out in the Baijiantan ophiolitic mélange are of two types: type 1 and type 2 lavas. The type 1 lavas occur within the fault zones as small blocks within

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the matrix of ultramafic rocks, tectonically juxtaposed against other rocks. The type 2 basalt lava came from the peperite-bearing unit. Besides the ultramafic rocks, gabbros, and basalt lavas, the other supracrustal rocks in the ophiolitic mélange include sandstone, chert, tuff, and very rare limestone. Sandstones predominate and most of them are tuffaceous; their characteristics are consistent with the sandstones from surrounding Lower Carboniferous sedimentary formations. Sandstone blocks within the mélanges also have detrital zircon age distributions (300-400 Ma) and characteristics similar to surrounding Carboniferous sediments. The rock assemblages in the mélanges indicate the ophiolitic mélanges consist of locally derived rocks, in contrast to conventional ophiolitic mélanges. The ophiolitic mélanges show classic structural features of strike-slip shearing regimes, including subhorizontal slickenside lineations (<20°), consistent steeply dipping foliation (>75°) in the matrix, and elongated shapes of blocks aligned parallel to the shear zone. Consistent shear-sense indicators including slip-fiber lineations, Riedel shears, asymmetric blocks, shear band cleavages and veins indicate a horizontal sinistral sense of movement. The occurrence of the amphibolite and ultramafic mylonite in the mélanges probably record early, deep-seated strike slip, indicating that the fault zones extended downward through the oceanic crust. The amphibolite-facies metamorphism then was superimposed by brittle deformation at a shallow level to form fault breccias during the mélange formation. So the ophiolitic mélanges originated from crustal-scale sinistral strike-slip fault zones, not as major plate boundaries or subduction-suture zones. The youngest units of the mélanges are the deformed blocks of Lower Carboniferous basin-fill sedimentary rocks, indicating that the ultimate formation of the mélanges was after deposition of the Lower Carboniferous strata (detrital zircon age modes:320-330 Ma), but before the age of the intruding granite and the dike cutting the mélanges (~310 Ma).

Based on above discussions and taking into consideration of the previous studies, a tectonic evolution scenario is proposed for the Devonian to Carboniferous in the West Junggar region. In the middle Devonian or earlier (> 390 Ma), a paleo-ocean basin existed, stretching across North Xinjiang from Darbut-Baijiantan area in West Junggar to the Kalamaili area in East Junggar. This basin was most likely a back-arc basin related to the Boshchekule–Chengiz–Yemaquan arc. Subduction ended in the paleo-ocean basin represented by the Hongguleleng-Kujibai-Armantai ophiolite belt by late Devonian (375-360 Ma), leading to slab break-off and upwelling of asthenosphere under the remnant ocean basin, which induced The OIB-like basalts in West Junggar. The oceanic basin started to receive sufficient sediment deposition into which OIB-like basalts flows could bulldoze to form the regional distributed peperites (~360 Ma). A little later, in the early Carboniferous (~340 Ma), continent-continent collision took place between the Junggar block and the Yemaquan arc, and Kalamaili ophiolite obduction occurred in the eastern part of Junggar block. The remnant ocean basin was preserved in the western part of the Junggar Block. Accompanying the relative motion between Junggar block and ocean basin in West Junggar during collision, a series of NW trending sinistral strike-slip faults were triggered and activated parallel to the western boundary of the Junggar block. During the late stage of the Early Carboniferous (~320 Ma), the remnant ocean basin was almost filled with sediments. The collision between the Yili and Junggar blocks at the beginning of the late Carboniferous reactivated the strike-slip faults, which disrupted the oceanic crust and basin-fill successions and caused diapirs of serpentinite to form the Baijiantan and Darbut ophiolitic mélanges. The emplacement of Upper Carboniferous (~310 Ma) stitching A-type granitoid plutons indicates the evolutionary history of the remnant ocean basin and strike-slip fault zone ophiolitic mélanges terminated by that time.

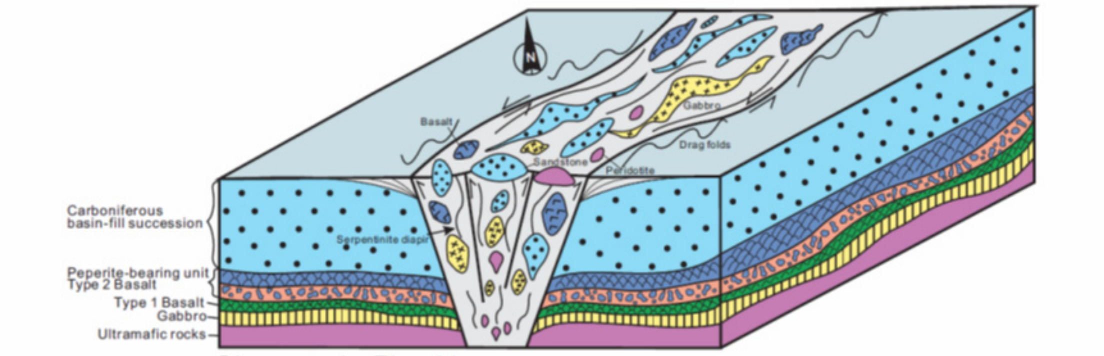

Fig. 1. Schematic diagram showing the oceanic crust, ocean basin-fill, fault zones and serpentinite mélange in West Junggar (not to scale).