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Precambrian Outline of Northwest China

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Precambrian rocks in the Northwest China are mainly exposed in the margins of the Tarim Platform and adjacent areas. Archaean rocks are well exposed in the eastern Alty Tagh and Dunhung area. The Palaeoproterozoic supracrustals are preserved at places in the above areas. It is worthy of note that the Neoproterozoic acid plutons in the region reflects some link between the geological history of the study area and the tectonic evolution from Rodinia to Gondwana.

Archaean granitoid gneiss complex

A single zircon U-Pb age of 3605±43 Ma from a granite-gneiss (Li et al., 2001) was reported in Aketashtage, east Altyn Tagh, which is located in the southeastern margin of the Tarim Platform. This U-Pb age provides geochronological information on the oldest crust in the Tarim Platform. Recently, the Early Precambrian sequence of magmatic activities has been established by field investigations and geochronological data. These magmatic activities include, from the oldest to youngest, the earlier granites (gneisses), monzonites (gneisses) and tonalites (preserving amphibolite enclaves) (Table 1).

Table 1. Magmatic activities in the study area and their ages

Magmatism	U-Pb age	Sm-Nd age	Method
Tonalite (gneiss)	2604±102 Ma	T_{DM} = 3063 Ma	TIMS
Monzonite (gneiss)	2830±45 Ma	T_{DM} = 2978 Ma	SHRIMP
Granite (gneiss)	3605±43 Ma	T_{DM} = 3528 Ma	SHRIMP

Based on the above U-Pb and Sm-Nd geochronological data, two crust-forming events, one at ~3.6 Ga - 3.5 Ga and the other at ~3.1 Ga - 3.0 Ga are identified. However, the magmatic event of the terminal Archaean is a crust-reworking activity. Altyn Tagh is not only the oldest crustal unit exposed in this area, but also the terrain where the Archaean magmatism is completely preserved in the Northwest China.

Some Archaean rocks are also preserved in Kuruktag in the northern and Dunhuang in the eastern margins of the Tarim Platform. Most important rock types of the Archaean

are tonalite, trondhjemite and granodiorite gneisses. Some enclaves of amphibolite are found within the gneisses at Kuruktag. However, supracrustal rocks are more widespread in the Dunhuang region. A U-Pb age of 2582±11 Ma from a granitic gneiss in Kuruktag was reported.

The Archaean tonalitic and trondhjemitic gneisses in the Dunhuang region show LREE-enrichments, HREE-depletions and positive Eu anomalies, similar to typical Archaean granitoids An upper intercept U-Pb age of 2670±12 Ma and a lower intercept age of 1017±3 Ma from the trondhjemitic gneiss have also been obtained. The former should represent the age of crystallization of the trondhjemite and the latter might reflect the age of a Neoproterozoic high-grade thermal event. The Nd model age of 2.68 Ga reported from the same sample, similar to the above U-Pb age, reflects an important crust-forming event in this area (Lu, 2002).

Paleo-Mesoproterozoic events

The Palaeoproterozoic and Mesoproterozoic rocks occur largely in the northern margin of Tarim, Central Qilian and the northern part of East Kulun Mountains. All these supracrustal rocks have been affected by amphibolite to granulite grade metamorphism. A number of Palaeoproterozoic ages are reported from the supracrustals and granitic gneisses. For example, U-Pb ages of 2412±14 Ma and 2366±10 Ma have been yielded from amphibolite and monzonitic gneisses, respectively, in the northern margin of the Qaidam Basin (Lu et al., 2002).

Because of polycycle tectonic movements, the Mesoproterozoic rocks are only preserved as small relics. Thus, it is difficult to subdivide and correlate the lithologies exposed in the above areas. For instance, the marbles of Yeimananshan Group are preserved as a small outcrop within a Caledonia granite batholith in the central Qilian Mountains, and quartz schists of this group, which was previously considered as a stratigraphic unit, are in fact mylonitized granites. U-Pb age of 1499±21 Ma was obtained from the mylonitized granites.

Neoproterozoic events

The Neoproterozoic rocks occur widely in the study area. The discovery of a large Neoproterozoic granitic gneiss belt at the north margin of the Qaidam basin has changed significantly the early ideas on the tectonic evolution and the stratigraphy of the area. According to the previous investigations, the Dakendaban Group preserved in the northern margin of the Qaidam basin was considered as a Palaeoproterozoic stratigraphic unit. The rocks occurring in the southern part of the margin are granitic gneisses, granodiorite and quartz monzonite, and only small outcrops of supracrustal rocks are preserved in the granitic gneisses as enclaves or relics. In contrast, tonalite and trondhjemite are only discovered as small bodies in the area. On the basis of new isotopic ages, the emplacement of the granites seems to have occurred in early Neoproterozoic (800 Ma-1000 Ma).

A lot of eclogite enclaves are preserved within the granite gneisses, and the determination of age of the eclogites is in progress. Ar-Ar age of 466.7±1.2 Ma from phengite has been reported (Xu et al., 1999), and Sm-Nd isochron age of minerals and

whole rock from the above eclogite is 545±8 Ma. U-Pb ages of 484±3 Ma and 474±5 Ma were reported from eclogites in Yuqiahe and Shaliuhe, respectively. The ages obtained by different methods suggest that an important event has occurred in this region between 500 Ma - 470 Ma, which is probably related to the Pan-African orogeny in Gondwana.

However, the "Dakendaban Group" has been redefined to the north of the granite gneisses belt mentioned-above (Lu et al., 2002). It is subdivided into two parts, i.e. the lower Delingha Complex and the upper Dakendaban supercrusts (Zhang et al., 2001). The Quanji Group, the first sedimentary cover, rests unconformably upon the Palaeoproterozoic basement. The stratigraphic sequence of the Quanji Group shows some features indicative of an aulacogen basin. Conglomerates and pebbly subarkoses are preserved in the lower part of the group. In the upper part sandstones and volcanics occur, which are overlain by thick marine carbonates with abounded stramatolites. Massive tillites are discovered at the top of the group, which is overlain by trilobite-bearing Cambrian strata with a paraunconformity. U-Pb single zircon age of 740 ± 16 Ma was obtained from volcanic rocks of this group (Li and Lu, 2001). Geochronological data mentioned above suggest that the unconformity between the Quanji Group and the metamorphic basement took place about 750 - 800 Ma ago (Lu, 2001).

Discussion

On the basis of new geological and geochronological data, the tectonic evolution of NW China can be summarised as follows.

1. Archaean rocks, composed mainly of TTG gneisses, are preserved in the Altyn Tagh-Dunhuang region. The oldest ages (3605±43 Ma) has been reported from a granitic gneiss sample in the northern Altyn Tagh.

2. Palaeoproterozoic strata are well developed in the study area and are exposed around the Archaean nuclei. The early Palaeoproterozoic rock mainly consists of meta-acid plutons and amphibolites that contains a number of meta-sedimentary rocks.

3. The Mesoproterozoic rocks are scattered in this region, and no volcanic rocks are found. Carbonaceous carbonates and pelites dominate the area.

4. Neoproterozoic magmatic events are well developed in the region, and the granite emplacement took place some 1000 Ma - 800 Ma ago. Several granite gneiss belts occur in the East Kulun-Northern Qaidam and South Beishan regions.

In the northern margin of the Qaidam Basin, an important unconformity between the overlying late Neoproterozoic Quanji Group and the underlying metamorphic basement is cropped out. U-Pb isotopic age of 740 ± 16 Ma has been yielded from volcanic beds

at the lower Quanji Group, and thus it is referred that the unconformity took place between 750-800 Ma ago.

~500 Ma ages reported from eclogites and other high-pressure metamorphic rocks may be the result of a possible late Pan-Africa event, which has to be established by more field investigations.

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