Archaean evolution of the Okhotsk terrane by U/Pb zircon chronology

N.G. BEREZHNAYA, V.K. KUZMIN, V.A. GLEBOVITSKY, E.V. TOLMACHEVA, D.I. MATUKOV, S.L. PRESNYAKOV, I.P. PADERIN AND S.A. SERGEEV

Centre of Isotopic Research, VSEGEI, St.-Petersburg, Russia (cir@vsegei.ru)

Okhotsk terrane (NE Russia) is a most aged segment of the Pacific mobile belt. The Kukhtuy domain, the largest (45x120 km) part of this terrane, mainly consists of polymetamorphic basalt-dacite series and metasediments, covered by Riphean and Paleozoic sediments.

For revealing the succession of geological processes we studied accessory zircons from four typical rock units: hypersthene-plagioclase granulite schist (HPS), garnet-hypersthene-plagioclase granulite schist (GHPS) – from Maymecha area and garnet-biotite gneiss (GBG), wall-rock for biotite granite-gneiss (BGG) – from Khorundzha area. Before U/Pb SIMS SHRIMP dating, zircons were subdivided into morphotype groups. The U/Pb ages are in Table.

Sample	Zircon group	Ma ± 2σ
HPS	1. Cores + volcanic FI, MI	3634±11
		3687±10
	2. Cores and rims + MI	3568±12
	3. Metamorphic grains + CO_2FI	3461±17
	4. Metasomatic zircons	2777-1372
GHPS	1. Cores + volcanic MI	3651±18
	2. Altered cores + volcanic MI	3507±17
	3. Rims on 1 & 2 + FI, MI	3446±52
	4. Rims + H_2O FI	2086±23
GBG	1. Zoned cores	3284±18
	2. Altered cores and rims	Discordia
	3. Altered zoned grains	3245±23-
		-2025±53
BGG	1.Cores+MI,FI and sector zoning	3330±20
	2. Rims + FI	2718±13

The following evolutionary succession is proposed for the Kukhtuy domain, Okhotsk terrane, based on U/Pb age data, zircon REE pattern, geochemistry, fluid (FI) and melt (MI) inclusion study.

I. Initial mafic volcanism 3.7-3.65 Ga ago. Hf data for the same zircons: $(^{176}Hf/^{177}Hf)i$=0,280575±20, εHf(t)=+3.4 show non-depleted magma source and 3.7-Ga protolith-mantle separation. **II.** First granulite facies metamorphic (ultra-metamorphic) event, 3.58-3.52 Ga ago. **III.** Second granulite metamorphic event (3.48-3.46 Ga). **IV.** Third granulite ultra-metamorphic event, accompanied by early Archaean anatexite granite, 3.33±0.02 Ga. **V.** Geochemical similarity of GBG and BGG zircon cores indicates the similar volcanic protolith for both gneiss units, which were formed during granulite event (3.33-3.28 Ga) and survived several late Archaean (2.72 Ga) and Proterozoic (2.09-2.03 Ga) amphibolite facies metamorphic events.

Age intervals for individual metamorphic events may indicate the difference in tectonic position of rock units.

Combining *in situ* isotope dating, petrology, and tectonic observations to infer rates of regional metamorphism

ALFONS BERGER[1], EMILIE JANOTS[1], MARTIN ENGI[1] AND DANIELA RUBATTO[2]

[1]Institut für Geologie, Universität Bern, Switzerland, (berger@geo.unibe.ch; ejanots@geo.unibe.ch; engi@geo.unibe.ch)

[2]ANU; Research Scchol of Earthscience; Canberra, Australia, daniela.rubatto@anu.edu.au

The determination of metamorphic rates demands high precision dating of samples for which the physical conditions of formation are well constrained. For such rates to be meaningful, the tectonic evolution of the sampled units needs to be established. We derive rates of metamorphism from in-situ dating of structurally controlled REE minerals combined with field observations in the Central Alps to gain insight into geodynamic rates.

In metamarls, the sequence of REE minerals reveals a series of irreversible reactions among silicates and phosphates. At diagenetic and low metamorphic conditions, detrital and newly formed monazite grains occur. Around 450°C, monazite disappears to form allanite, which is oriented in the main foliation. At temperatures >570°C, allanite is replaced by monazite, which grows after the development of the main foliation S_m. Garnet also overgrows S_m but predates monazite. These observations hold information on different processes: (1) collision and tectonic thickening, (2) regional heating, and (3) post-collisional folding. Th-Pb and U-Pb dating of allanite and monazite yields ages of 31.5±1.3 Ma and 18.0±0.1 Ma, respectively. Considering that the difference of 13.5 Ma between the two ages represents the T-interval from 450°C to 570°C, the average heating rate is 8-10°/Ma.

This rate may relate to a combination of processes, involving at first substantial tectonic transport (advective heating dominant). This stage is followed bya period of minor tectonic transport, post nappe folding and thermal relaxation, when conductive heat transport dominates.

Tectonothermal modeling (2D FEM) yields similar heating rates for units in front of the nappe stack, which is being exhumed owing to erosion and tectonic unroofing. Late orogenic heating during decompression lead to the thermal maximum in this external portion of the orogen 18-15 Ma ago, at a later stage than in the internal segment of the Central Alps (~30-22 Ma ago just north of the Insubric Line). In the latter part of the orogen, the metamorphic rates are largely dominated by advection due to tectonic extrusion of thrust sheets, i.e. units previously subducted. In the external parts of the Lepontine dome, the thermal field and metamorphic patterns evolved later, and rates reflect the heating followed by rapid cooling during orogenic exhumation.