Tectonophysics Modeling of Baimka Ore Zone (Western Chukotka)

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Abstract

Baimka ore zone (BOZ) containing the greatest in Russia Au-Cu-porphyry deposit "Peschanka" located in Alazey–Oloy fold belt and associated with Late Jurassic–Early Cretaceous volcanic belt complex. Ore zone originated in regional Aluchin fault, which controlled localization of intrusive bodies, Cu-porphyry systems, Au-Ag-polymetallic occurrences and placer gold deposits. Different-scaled paragenesis examinations led to interpret of these faults as right-hand shear, at the same time, to evidence a reverse movement by these shear zones with the left-hand shear preceding the right-hand shear movement. Ore localization controlled by deformation and several deformation phases results in heterogeneity of the environment that leads to complication of stress fields. The deformation process physical modeling in ore zone is an actual challenge, and experiments for shear zones with several intersecting sinuous faults and reverse movement have not been described so far. Tectonophysics modeling of Baimka ore zone performed at Moscow State University tectonophysics laboratory using modeling table with special modeling tool was constructed: a rectangular box made of four blocks that can be rotated over each other changing the form of the box from rectangle to parallelogram. Structural pattern of BOZ corresponds to two-phase reverse model of shear zones. Main faults were created in a left-hand shear and reactivated in right-hand shear conditions. Ore stock works and veins are concentrated in sites of local tension of right-hand shear. Modeling data can be used for the prognostication of ore zones. The main model fissures correspond to poorly studied potential ore fields allocated formerly in BOZ.

Keywords

Baimka ore zone • Tectonophysics modeling • Au-Cu-porphyry Peschanka deposit • Alazey–Oloy fold belt • Okhotsk–Chukotka magmatic belt

1 Baimka Ore Zone Structural Position

Baimka ore zone (BOZ) containing the greatest Au-Cu-porphyry deposit "Peschanka" in Russia is located in Alazey–Oloy fold belt and associated with Late Jurassic–Early Cretaceous volcanic belt complex (Fig. 1). The ore zone extended more than 170 km in NW direction parallel to South Anyuy suture and originated from deep regional Aluchin fault, which controlled the localization of Early Cretaceous ore-forming intrusive bodies and Cu-porphyry systems, Au-Ag-polymetallic occurrences and placer gold deposits associated with them. BOZ is about 20 km in width on the SE overlain by Late Cretaceous volcanic rocks of Okhotsk–Chukotka magmatic belt. Hypabyssal intrusive of diorite and monzodiorite complexes burst folded volcanic–sedimentary Late Jurassic–Early Cretaceous deposits. The main deformation structures near the surface are several subparallel to BOZ slightly sinuous crossing faults (Fig. 2).

2 Tectono-Physical Modeling of Fault Structure Zone

Tectonophysics modeling of Baimka ore zone performed in collaboration of Moscow State University tectonophysics laboratory as an experiential equipment base, Polyus Gold LCC as an exploration company, interested in ore structure survey for BOZ and Institute of GeoTechnology as

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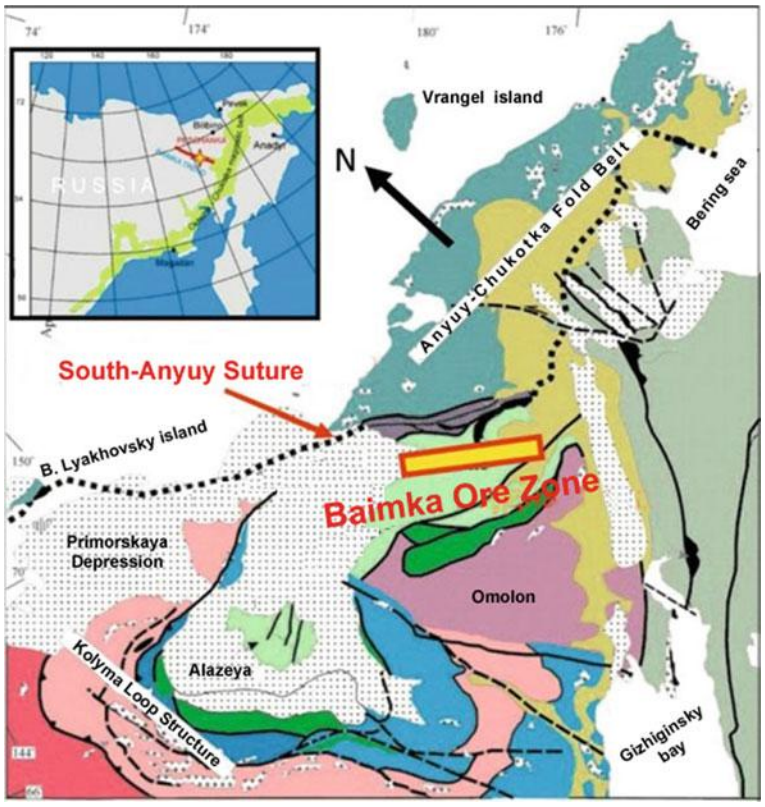

Fig. 1 Baimka ore zone in North-East Eurasia structure (Chitalin et al. 2013)

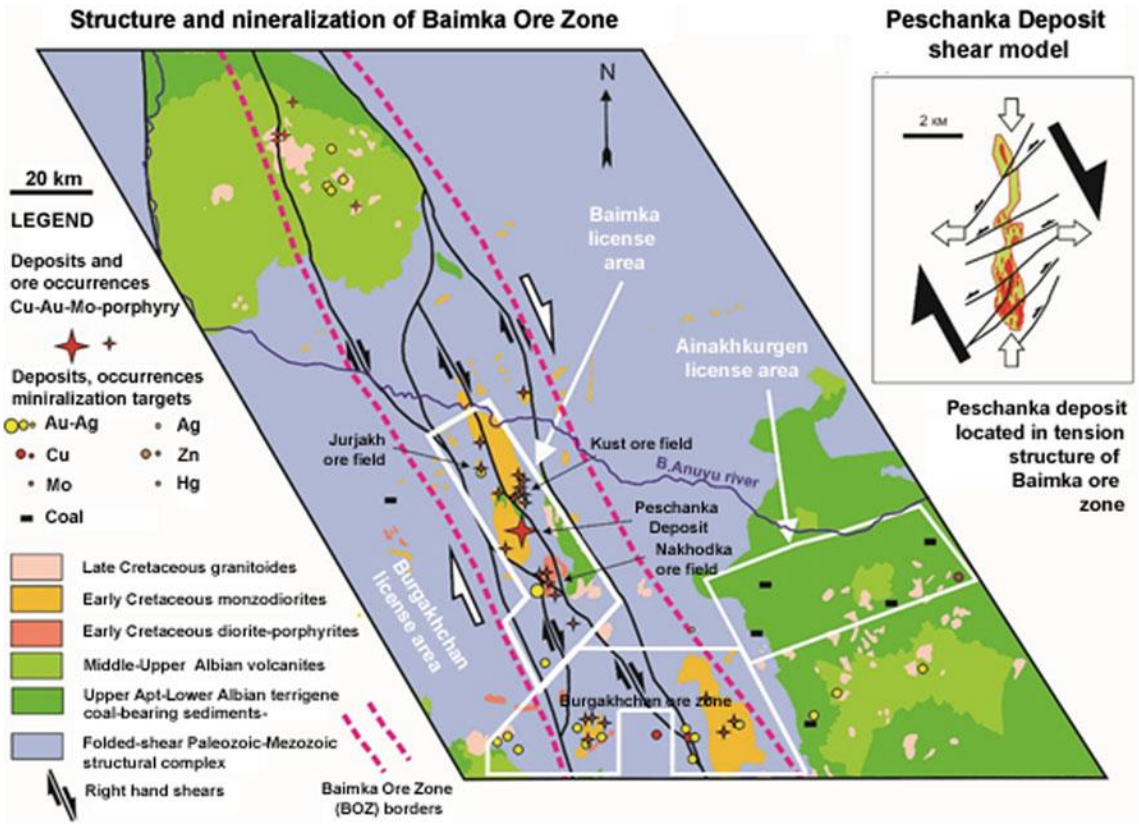

Fig. 2 Main fault structures of Baimka ore zone (Chitalin et al. 2013)

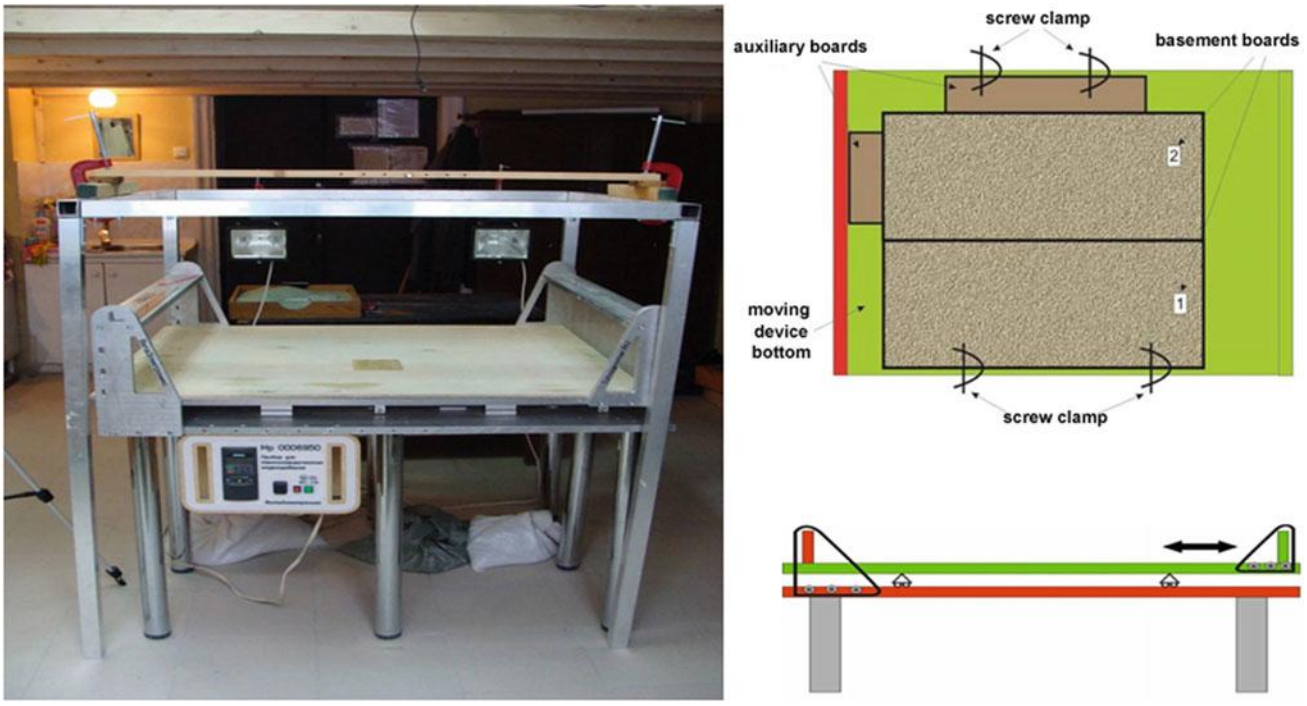

Fig. 3 Modeling table scheme in MSU tectonophysics lab. (Frolova 2017–2018)

expert organization in Baimka zone structures, explored "Peschanka" deposit for a long time (Fig. 3).

The modeling was performed on original tectonophysics instrumentation—modeling table with two borders, one of which is moving together with a tabletop. The device was equipped with an engine that kept the necessary speed conditions. For BOZ modeling, special modeling tool constructed: rectangular box made of four blocks that can be rotated over each other changing form of box from rectangle to parallelogram. On the bottom of the Box 31 Plexiglas rails of 1 cm width. This construction mounted to main tectonophysics instrumentation in a way that allows us to equally show all the zone in one and opposite directions for modeling reverse right-hand and left-hand shears. Silicone layer was

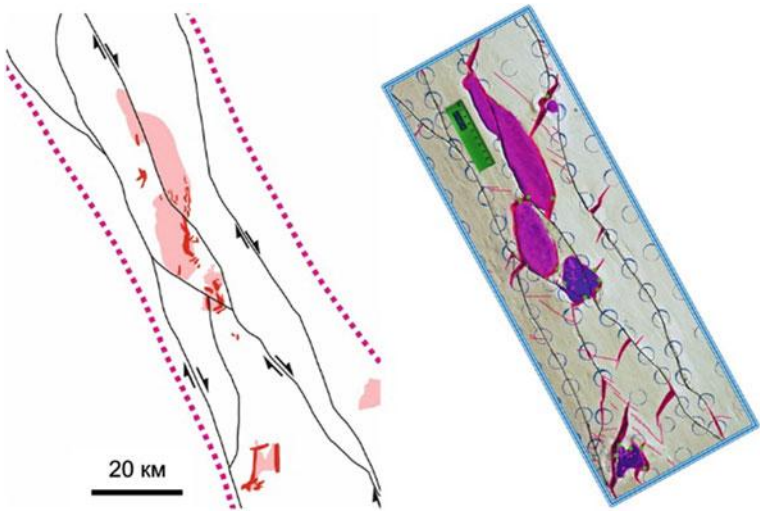

Fig. 4 Structural pattern and results of modeling BOZ (Frolova 2018)

placed on the rails under wet clay or sand sample that contains faults modeling real BOZ fault system (made by pattern). Experiments were performed with one- and two-layer models on wet clay and sand samples, as suitable equivalent material for analog deformation modeling (Atmaoui et al. 2006).

3 Results and Models

Using the equipment, serial of experiments performed including

- Right-hand shear in viscous bedrock under homogeneous covering;
- Right-hand shear and reverse left-hand shear in viscous bedrock without dividing bedrock and covering using clay and sand material;
- Viscous clay, one-stage deformation;
- Minor viscous clay, one-stage deformation;
- Minor viscous clay, two-stage reverse deformation;
- Minor viscous clay, one-stage deformation with model of intrusive bodies.

More than 30 experiments totaling about 600 hours of modeling time were conducted (Fig. 4).

Structural pattern of BOZ corresponds to two-phase reverse model of shear zones. The main faults were created in a left-hand shear and reactivated in right-hand shear conditions.

Ore stock works and veins were concentrated in the sites of local tension of the right-hand shear. The modeled data can be used for the prognostication of ore zones. The main model fissures correspond to poorly studied potential ore fields allocated formerly in BOZ.

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