NEW PALAEOPIEZOMETER AND ITS APPLICATION FOR ESTIMATION OF INJECTED ANORTHOSITE MAGMA PRESSURE

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A new palaeopiezometer has been designed and applied for estimation of magma pressure ($\mathbf{P_m}$) during intrusion of anorthosites of the Geran massif (Ulkan–Dzhugdzhur anorthosite–rapakivi granite complex, Aldan shield, Russia) (1.73–1.70 Ga). This piezometer is based on the analysis of twin-density in crystals deformable plastically by mechanical twinning (e.g. plagioclases). Theoretical equation expressing the differential stress (**s**) as a function of the twin density (**D**) was obtained in the following form:

$$s = XG \lg[1 + Y(D/S) - Z(a_2/S)] \quad (1)$$

Where:

G = shear modulus, **S** = shear magnitude (coefficient) for mechanical twins, **a** = average lattice parameter (**G, S, a** are constants characterizing the material)

X = $4.75 \cdot 10^{-3}$, **Y** = 0.345 mm^{-1}, **Z** = 1.716 mm^{-2} (**X, Y, Z** are constants, obtained from experimental data s(D) for calcite twinning (cf. Rowe & Rutter 1990)).

Equation (1) was applied to palaeostress estimation for plagioclase-bearing rocks of the Geran anorthosite massif. The parameter **D** was measured for pericline and albite twins in plagioclase. The values of differential stress **s** were obtained using Eq. (1) for various samples: for anorthosites from the centre of the massif ($s_1 = 0$) and near the contact zone (s_2 = 211 MPa), for granulite near the contact zone (s_3 = 291 MPa), 1 km (s_4 = 257 MPa) and more than 2 km away from the contact zone (s_5 = 176 MPa). Errors of the differential stress values did not exceed 88 MPa. The absolute maximum of **s** was observed near the contact zone. The maximum may have been induced by injected anorthosite magma pressure P_m, which was greater than lithostatic pressure P_l for granulite: $P_m - P_l = s$. Using the well-known value for the P_l, the estimation of the unknown magma pressure P_m was obtained:

$$P_m = P_l + (s_3 - s_5) = P_l + s_2 = 0.8 \pm 0.1 \text{ GPa}$$