

P-wave velocities of deep crustal rocks from Kohistan arc up to 1000 C and 1 GPa

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We report laboratory measurements of V_p at high P-T (25-1000 C and up to 1GPa) for lower crustal rocks exposed in the Kohistan area, northern Pakistan. The Kohistan area has been known as one of the well exposed crustal sections. In the Kohistan area, various arc-type rocks are widely distributed, including volcanic rocks, sedimentary rocks, granitic to gabbroic rocks, high-grade metamorphic rocks and ultramafic rocks. We measured V_p for gabbro, pyroxene granulite, garnet granulite and garnet pyroxenite up to 400C and 0.1-1GPa, and for gabbro, pyroxene granulite, websterite, wehrlite and dunite up to 1000C at 1 GPa. The V_p values at 1 GPa and 25C are 7.24 and 7.29 km/s for gabbros, 7.35 and 7.37 km/s for the pyroxene granulites, 7.68 km/s for the garnet granulite, 7.91 and 8.37 km/s for the garnet pyroxenites, 7.80 km/s for the websterite, 8.01 km/s for the wehrlite, and 8.49 km/s for the dunite. Pressure derivative of V_p at 25C and 0.3-1.0 GPa is 0.12 km s⁻¹ GPa⁻¹ for the gabbro, 0.22 km s⁻¹ GPa⁻¹ for the pyroxene granulite, 0.12 km s⁻¹ GPa⁻¹ for the garnet granulites, 0.08 and 0.19 km s⁻¹ GPa⁻¹ for the garnet pyroxenites. Temperature derivatives of V_p at 1 GPa is -2.4×10^{-4} km s⁻¹ C⁻¹ (25-400C) and -4.3×10^{-4} km s⁻¹ C⁻¹ (400-1000C) for the gabbros, -2.9×10^{-4} km s⁻¹ C⁻¹ (25-400C) and -4.4×10^{-4} km s⁻¹ C⁻¹ (400-1000C) for the pyroxene granulites, -2.2×10^{-4} km s⁻¹ C⁻¹ (25-400 C) for the garnet granulite, -1.5 and -2.3×10^{-4} km s⁻¹ C⁻¹ (25-400C) for the garnet pyroxenites, -2.2×10^{-4} km s⁻¹ C⁻¹ (25-800C) and -3.8×10^{-4} km s⁻¹ C⁻¹ (900-1000C) for the websterite, -4.2×10^{-4} km s⁻¹ C⁻¹ (25-600C) and -5.3×10^{-4} km s⁻¹ C⁻¹ (700-1000C) for the wehrlite, and -5.3×10^{-4} km s⁻¹ C⁻¹ (25-800C) and -7.1×10^{-4} km s⁻¹ C⁻¹ (900-1000C) for the dunite. Employing the present data of average pressure derivatives of V_p and measured temperature derivatives of V_p and taking the constant geothermal gradient (25C/km), we calculate V_p values of lower crustal rocks. The calculated V_p values of gabbro are at 10, 20, 30 km depth are, respectively, 7.09 km/s at 10 km depth, 7.05 km/s at 20 km depth, and 6.99 km/s at 30 km depth. Similarly, we obtain V_p of 7.18 km/s (10 km depth), 7.14 km/s (20 km depth) and 7.08 km/s (30 km depth) for pyroxene granulite, 7.65 km/s (10 km depth), 7.64 km/s (20 km depth) and 7.64 km/s (30 km depth) for websterite, 7.81 km/s (10 km depth), 7.75 km/s (20 km depth) and 7.70 km/s (30 km depth) for wehrlite, and 8.26 km/s (10 km depth), 8.18 km/s (20 km depth) and 8.09 km/s (30 km depth) for dunite.