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Modeling the Lower Crustal Flow beneath the Tibetan Plateau

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The ductile flow beneath the Tibetan Plateau is accepted widely. It was even thought to be an important reason behind the Ms8.0 Wenchuan earthquake in 2008. However, there are disputes on the way and speed of the lower crustal flow. There are direct measurements of surface motion such as GPS, and indirect measurements of the upper mantle movement such as S-wave splitting. As to lower crustal movement, there is no direct observation so that numerical analysis is very important. In this study, we construct a three-dimensional viscoelastic finite element model of the Tibetan Plateau to simulate the crustal flow pattern. The viscosity varies with depth. According to the previous knowledge about the pattern of the lower crustal flow of the plateau, several cases with different constraints are tested. We compare the modeled and observed velocity under different cases. Modeling results show that, the lower crust outflows the plateau at its southeast corner. On the basis of such knowledge, we further study how fast it moves. Using different kinds of data, researchers estimated the viscosity of the lower crust to be 10^{17} and

10^{20} Pa.s. When the viscosity is 10^{17} Pa.s, the lower crust moves dozens of millimeters faster than the upper crust. When viscosity increases to 10^{20} Pa.s, there is little difference between the upper and lower crust. If lower crust moves as fast as 100 mm/a, it equals 1000 km in 10 Ma time scale, and the viscosity should be lower than 10^{17} Pa.s, but there is no evidence for it. We suggest that the eastward flow the ductile lower crust in the Tibetan Plateau is resisted by the Sichuan Basin, a channel exists in the south-eastern corner of the plateau, and similar substances channel does not exist on the northeast corner of the plateau. The lower crust beneath the Tibetan Plateau moves several millimeter faster than the upper crust, that indicates the corresponding viscosity of the lower crust of the Tibetan Plateau is between 10^{18} Pa.s and 10^{19} Pa.s. It is generally consistent with others' observations.

Key words: Tibetan Plateau, lower crustal flow, finite element, viscos-elastic

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