On 14 April 2010, the Mw 6.9 Yushu, Qinghai earthquake occurred at the eastern margin of the Tibetan plateau along the Yushu-Ganzi-Xianshuihe fault, which is one of the most active fault zones in eastern Tibet. Interferometric synthetic aperture radar data from ALOS ascending orbits, Envisat descending and ascending orbits are used to map the rupture geometry and surface displacements produced by the event. Based on previous geological and geophysical studies, a layered crustal structure and a three-segment rupture model are established to study the coseismic slip on the fault at depth. Using the constrained least-squares method, a preferred coseismic slip model is derived from ALOS and Envisat observations. The InSAR-derived moment is about Mw 6.9, which is consistent with the seismic moment. Aftershocks were primarily distributed below the section of the fault that ruptured coseismically.