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利用接收函数和大地电磁数据联合反演南迦巴瓦构造结中部地区壳幔结构

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Joint inversion of receiver functions and magnetotelluric data: Application to crustal and mantle structure beneath central Namche Barwa, eastern Himalayan syntaxis

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摘要 利用2010年布设在西藏南迦巴瓦构造结的郎嘎、崩嘎、直白和拉格四个宽频地震台所观测到的近5个月的地震记录,采用时间域迭代反褶积技术处理得到接收函数,通过筛选多条相近震中距和反方位角的高质量接收函数求取其叠加平均.对大地电磁数据做Rhoplus分析处理得到视电阻率和相位曲线.利用单台接收函数和相同位置的大地电磁视电阻率和相位联合反演地下一维壳幔结构.联合反演采用遗传算法,并通过权衡图分析大地电磁和地震数据的兼容性.理论值和实测值的对比显示两种数据能同时得到较好拟合.联合反演结果表明:(1)中上地壳为9 km至14 km厚的高阻高速层覆盖于低阻低速层之上的结构,中地壳低阻低速层可能与深部流体和局部熔融共同作用有关.(2)下地壳存在最厚达20 km的高导的壳幔过渡层,波速在4 km/s左右;上地幔约130 km至150 km以下存在软流圈.(3)上地壳的高阻高速层解释为多雄拉组混合岩化角闪岩相变质岩,而直白台所显示的低阻低速层与高压麻粒岩的少量部分熔融有关,可能源于壳幔过渡带镁铁质岩石的相变或更深处幔源岩浆底侵作用的产物.

关键词 联合反演, 接收函数, 大地电磁测深, 南迦巴瓦, 遗传算法

Abstract: Using tele-seismograms from four stations (Langga station, Bengga station, Zhibai station and Lage station) for about five months in the central Namche Barwa, eastern Himalayan syntaxis in Tibet, we calculated receiver functions by time-domain iterative deconvolution technique and selected high-quality receiver functions with similar epicentral distances and back azimuths and then stacked them. Magnetotelluric apparent resistivity and phase curves are obtained by Rhoplus analysis of Berdichevskiy invariant of impedance tensors. The average receiver function and apparent resistivity and phase data from the same station are jointly inverted for one-dimensional Earth to infer lithospheric structure. Using genetic algorithm, we analyzed the compatibility between the magnetotelluric data and the seismic data by trade-off plots. The comparison of predicted data and measured data manifests that they coincide on both data sets. The results demonstrate:(1) In the mid-upper crust, a high resistivity, high velocity layer (9~14 km thickness) overlays a low resistivity and low velocity layer which may be related to aqueous fluids and partial melts. (2) There exists a highly conductive crust-mantle transition layer (thickness <20 km) with the S wave velocity of ~4 km/s in the lower crust, and also exists the lithosphere-asthenosphere boundary deeper than 130~150 km in the upper mantle. (3) A possible interpretation about the high resistivity and high velocity layer in the upper crust is the migmatitic amphibolite facies (Duoxiongla Formation), while the low resistivity, low velocity layer beneath the Zhibai station is associated with partial melting. And high-pressure granulite facies may originate from petrological transformation of mafic rocks in the crust-mantle transition layer or from mantle-derived magma underplating.

Keywords Joint inversion, Receiver function, Magnetotellurics, Namche Barwa, Genetic algorithm

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