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大地水准面异常在湖南地区的地球物理解释

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On the use of the geoid anomalies for geophysical interpretation over the area of Hunan

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摘要

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摘要 以湖南地区为例,利用超高阶地球重力位模型EGM2008计算了研究区的重力大地水准面,并采用棱柱体公式和球体公式相结合的方法分别进行了完全地形改正和Airy-Heiskanen局部均衡改正,得到布格大地水准面和均衡大地水准面.对三种大地水准面进行不同波长分量的分离处理,得到包含不同深度异常信息的剩余大地水准面,并结合其他地球物理资料对研究区进行了详细的地球物理解释.结果表明,剩余重力大地水准面可以有效地反映出研究区内的深部构造特征,如深大断裂带分布、构造块体位置、上地幔密度横向分布等,但对地壳内异常结构反映不明显;研究区岩石圈密度变化相对平缓,厚度由东向西增加;根据剩余均衡大地水准面及研究区Airy局部均衡莫霍面,可以大致推测出研究区的莫霍面起伏形态以及均衡状态,可作为一种有用的参考信息.

关键词 EGM2008地球重力位模型, 大地水准面异常, 地球物理解释, 地壳均衡状态, 莫霍面起伏

Abstract: In this paper, we investigated the applications of geoid anomalies in geophysical interpretation. The ultra-high geopotential model EGM2008 is used to compute the gravimetric geoid, and the corresponding Bouguer and isostatic geoids are obtained from complete topographic and Airy-Heiskanen local isostatic corrections with a synthetic method combining the prism and tesseroid approaches. Then the geoids are divided into several residuals which represent anomalous features in different depths, by removing different wavelength components. Finally, a case study over the Hunan area based on these data sets and other geophysical data is presented. The results show that the residual gravimetric geoids can reveal some anomalous structures in deep earth effectively, such as the distributions of deep rifts, the locations of tectonic blocks and the lateral density distribution in the upper mantle etc.. However, the anomalous features in the crust are not evident in these residuals. The variation of density anomalies in the lithosphere is much smoother than that in the shallower depth, while the thickness of the lithosphere deepens from east to west. The Moho undulations, and the isostatic state of the research area which can be regarded as complementary information, are inferred roughly from the analysis of both the residual isostatic geoids and Airy local isostatic Moho depths. The results showed above give us a new way to overcome the absence and sparseness of gravity data in remote areas for geophysical interpretation.

Keywords EGM2008 geopotential model, Geoid anomalies, Geophysical interpretation, Crust isostatic state, Moho undulations

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