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Three - dimensional magnetotelluric imaging crustal zones using the artificial neural network approach

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Artificial neural network (ANN) approach enables fast imaging earth's crust basing on insufficient, noisy and interrelated data (Spichak and Popova, 2000; Spichak et al., 2002). In the present work it is applied to reconstruction of the specific resistivity models of the earth's interior from magnetotelluric (MT) data measured at the earth's surface.

The ANN is based on the backpropagation technique with the number of neurons optimized so that to provide the best fitting to the teaching data. Depending on their type, ANN could be taught in two ways. First, by the correspondence between the modeling data and appropriate models, if the synthetic data base is available, and, second, by the data, consisting from the Bostick transformation of the apparent resistivity determinant that enables to correspond each data measured at the surface directly with spatial resistivity distribution in the earth. After teaching the ANN is used in order to reconstruct the resistivity structure in the studied area.

Case studies of 3D resistivity models of the faults and volcanoes are discussed. Scalar controlled source audio-magnetotellruc data collected in a northern part of the Minou fault area (Kyushu Island, Japan) are interpreted by means of the ANN Expert System MT-NET in terms of 3-D earth macro-parameters. A number of synthetic responses created in advance by means of forward modeling in typical 3-D geoelectrical models (conductive and resistive local bodies, fault, dyke, etc.) formed samples for teaching ANN. The best-fitting model reconstructed by ANN belongs to the guessed model class formed by "dykes buried in the two-layered earth", on the one hand, and to the equivalence class formed by all models giving *rms* misfit less than the noise level in the data, on the other hand.

Another example of the ANN inversion regards the resistivity model of the potentially active Elbrus volcano (Northern Caucasus). It is built basing on profile MT data taking into account solid model of tectonic fragmentation field developed on the base of satellite images' decoding. With this purpose the original method of search of the correlation and the character of interrelation between ground and satellite data is applied that enables to restore the missing geophysical information. The geoelectrical model built contains relatively conducting body at the depth 40 km approximately (with specific resistivity 10-35 Ohm and dimensions 35 km, 15 km and 20 km on width, length and depth, accordingly) that can be interpreted as a magma conduit.

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