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2D magnetotelluric inversion using reflection seismic images as constraints and application in the COSC project

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We introduce a new constrained 2D magnetotelluric (MT) inversion scheme, in which the local weights of the regularization operator with smoothness constraints are based directly on the envelope attribute of a reflection seismic image. The weights resemble those of a previously published seismic modification of the minimum gradient support method introducing a global stabilization parameter. We measure the directional gradients of the seismic envelope to modify the horizontal and vertical smoothness constraints separately. An appropriate choice of the new stabilization parameter is based on a simple trial-and-error procedure. Our proposed constrained inversion scheme was easily implemented in an existing Gauss-Newton inversion package. From a theoretical perspective, we compare our new constrained inversion to similar constrained inversion methods, which are based on image theory and seismic attributes. Successful application of the proposed inversion scheme to the MT field data of the Collisional Orogeny in the Scandinavian Caledonides (COSC) project using constraints from the envelope attribute of the COSC reflection seismic profile (CSP) helped to reduce the uncertainty of the interpretation of the main décollement. Thus, the new model gave support to the proposed location of a future borehole COSC-2 which is supposed to penetrate the main décollement and the underlying Precambrian basement.