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A 3D Magnetotelluric Perspective on the Galway Granite, Western Ireland

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Magnetotelluric (MT) and audi-magnetotelluric (AMT) data were acquired at 75 locations across the exposed calc-alkaline Caledonian Galway granite batholith and surrounding country rocks into which the granite intruded.

The Galway granite is located in western Ireland on the north shore of Galway bay, and has an ESE-WNW long axis. The granite is cut by trans-batholith faults, the Shannawona Fault Zone (SFZ) in the western part of the batholith, which has a NE-SW trend, and the Bearna Fault Zone (BFZ) in the eastern sector that has a NW-SE trend. Geobarometry data indicate that the central granite block between these fault zones has been uplifted, with the interpretation being that the granite in this central block is thinned. To the west of the SFZ, much of the Galway granite is below sea level, with the majority of the southern granite contact also beneath the sea in Galway bay. To the east of the batholith, the Carboniferous successions, consisting of mainly limestone with shale, overlie the basement rocks. The country rock to the north includes the metagabbro-gneiss suite, which itself intruded the deformed Dalradian successions that were deposited on the Laurentian margin of the Iapetus Ocean. The deformation of the Dalradian rocks, the intrusion of the metagabbro-gneiss suite and the intrusion of the Galway granite were major events in the protracted closure of the Iapetus Ocean.

It is clear from geological mapping, from geobarometry and from the present submergence by the sea of a large part of the Galway granite, that inversion of MT data in this structurally complex geology is likely to require a 3D approach.

We present a summary of 3D inversion of the Galway MT and AMT data. The study shows that the structure of the Galway granite is quite different from the pre-existing perspective. The central block, thought by its uplifting to be thinned, is shown to be the thickest part of the batholith. A geological model of granite intrusion is offered to explain this structure.