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Joint inversion of gravity and electromagnetic data — New constraints on the 3-D structure of the lithosphere beneath Central Mongolia

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Joint inversion of complementary datasets is an important tool to gather new insights and aid interpretation, especially in regions which show structural complexity. Using the joint inversion framework jif3D [1] with a newly developed coupling for density and resistivity, based on a variation of information approach which is a machine-learning method that constructs a possible relationship between the properties [2], we combine satellite gravity measurements with electromagnetic data, from broadband and long-period magnetotellurics [3,4,5,6].

Central Mongolia is located in the continental interior, far from tectonic plate boundaries, yet has a high-elevation plateau and enigmatic widespread low-volume basaltic volcanism [7,8,9]. The processes responsible for developing this region remain unexplained and there are questions about its tectonic evolution. A recent project employed thermo-mechanical numerical modeling [10] to simulate the temporal evolution of various tectonic scenarios, offering an opportunity to test hypotheses and determine which are physically plausible mechanisms. Constraints on lithospheric properties, e.g., density distribution, are important for evaluating the geodynamic models. Furthermore, they can help shed light on questions regarding the nature of lower crustal electrical conductors [11], which may be related to tectonically-significant low-viscosity zones.

We will present preliminary results that provide new constraints on the 3-D structure of the lithosphere beneath Central Mongolia, as well as a roadmap for moving towards integrating geophysical results into geodynamic modeling to better understand the evolution of the lithosphere.

References:

[1] Moorkamp, M. et al. 2011. A framework for 3-D joint inversion of MT, gravity and seismic refraction data. *Geophysical Journal International*, **184**(1). https://doi.org/10.1111/j.1365-246X.2010.04856.x

[2] Moorkamp, M., 2021. Deciphering the state of the lower crust and upper mantle with multi-physics inversion. *ESSOAr*. https://doi.org/10.1002/essoar.10508095.1

[3] Comeau, M.J., et al., 2018. Evidence for fluid and melt generation in response to an asthenospheric upwelling beneath the Hangai Dome, Mongolia. *Earth and Planetary Science Letters*, **487**. https://doi.org/10.1016/j.epsl.2018.02.007

[4] Käufl, J.S., et al., 2020. Magnetotelluric multiscale 3-D inversion reveals crustal and upper mantle structure beneath the Hangai and Gobi-Altai region in Mongolia. *Geophysical Journal International*, **221**(2). https://doi.org/10.1093/gji/ggaa039

[5] Becken, M., et al., 2021a. Magnetotelluric Study of the Hangai Dome, Mongolia. *GFZ Data Services*. https://doi.org/10.5880/GIPP-MT.201613.1

[6] Becken, M., et al., 2021b. Magnetotelluric Study of the Hangai Dome, Mongolia: Phase II. *GFZ Data Services*. https://doi.org/10.5880/GIPP-MT.201706.1

[7] Comeau, M.J., et al., 2021a. Images of a continental intraplate volcanic system: from surface to mantle source. *Earth and Planetary Science Letters*, **587**. https://doi.org/10.1016/j.epsl.2021.117307

[8] Papadopoulou, M., et al., 2020. Unravelling intraplate Cenozoic magmatism in Mongolia: Reflections from the present-day mantle or a legacy from the past? *Proceedings of the EGU*. https://doi.org/10.5194/egusphere-egu2020-12002

[9] Ancuta, L.D., et al., 2018. Whole-rock 40Ar/39Ar geochronology, geochemistry, and stratigraphy of intraplate Cenozoic volcanic rocks, central Mongolia. *Geological Society of America Bulletin*, **130**. https://doi.org/10.1130/b31788.1

[10] Comeau, M.J., et al., 2021b. Geodynamic modeling of lithospheric removal and surface deformation: Application to intraplate uplift in Central Mongolia. *Journal of Geophysical Research: Solid Earth*, **126**(5). https://doi.org/10.1029/2020JB021304

[11] Comeau, M.J., et al., 2020. Compaction driven fluid localization as an explanation for lower crustal electrical conductors in an intracontinental setting. *Geophysical Research Letters*, **47**(19). https://doi.org/10.1029/2020gl088455