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The deep structure of the Richat magmatic intrusion (northern Mauritania) from geophysical modelling. Insights into its kinematics of emplacement

El Houssein Abdeina^{1,2}, Sara Bazin³, Gilles Chazot³, Hervé Bertrand⁴, Bernard Le Gall³, Nasrddine Youbi², Mohamed Salem Sabar¹, Mohamed Khalil Bensalah², and Moulay Ahmed Boumehdi²

¹Department of Geology, Faculty of Sciences and Techniques, University of Nouakchott Al-Aasriya, BP 5026, Nouakchott, Mauritania

²Department of Geology, Faculty of Sciences Semlalia, Cadi Ayyad University, Prince Moulay Abdellah Boulevard, P.O. Box 2390, Marrakech, Morocco

³Laboratoire Géosciences Océan, Institut Universitaire Européen de la Mer, place Copernic, 29280 Plouzané, France

⁴Univ Lyon, ENSL, Univ Lyon 1, CNRS, LGL-TPE, F-69007 Lyon, France

The famous circular structure of Richat, sometimes referred to as “the eye of Africa”, is located in the northwestern part of the Taoudeni basin, in the central part of the Mauritanian Adrar plateaus. It is expressed at the surface as a slightly elliptical depression, about 40 kilometers in diameter, marked by concentric ridges of Proterozoic-Lower Paleozoic sediments. Its origin as resulting from either a meteorite impact or a deep magmatic intrusion, has been long debated. Modelling of high-resolution airborne magnetic data as well as satellite gravity data reinforces the intrusion hypothesis. Geophysical modelling has been calibrated by determinations of rock properties from various types of magmatic lithologies sampled in the field. The three complementary types of geophysical data allow us to image at various scales and depths the buried structures of the Richat magmatic complex, to determine the areas most affected by hydrothermal alteration and finally to elaborate a kinematic model for its emplacement. We emphasize that : (1) the Richat intrusion is characterized by the presence of two important circular magnetic signals that coincide with gabbroic ring dykes partly exposed at the surface, (2) its overall circular structure rests above a deep mafic (gabbroic) body, (3) the upwelling of magma at the surface has been facilitated by the presence of concentric faults and (4) the central zone of the complex recorded intense hydrothermal alteration. This case study aims to provide insights for similar types of magma-induced ring structures observed worldwide.