



# Investigation of structural controls on the drainage system of north-western Nigeria

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## Abstract

Gravity and magnetic field datasets coupled with Shuttle Radar Topography Mission (SRTM) digital elevation data over north-western Nigeria were interpreted to delineate subsurface and surface structures, and determine their influence on the drainage system within Sokoto Basin and its surrounding environment. The Improved Logistic Filter and Euler Deconvolution techniques were applied to the residual fields of the gravity and magnetic data to delineate lineaments and their depths of occurrence, respectively. The lineaments mapped from gravity and magnetic data revealed a major N–S and NE–SW, and W–E trend respectively and in several cases were aligned with surface lineaments from the SRTM digital elevation data. The results revealed that the drainage channel of Rivers Niger, Sokoto, Rima, Zamfara, Ka, Kasanu, Gagere, Kuromoni, Malendo and Kontagora are closely aligned with several lineaments emanating from the underlying basement. The 2-D forward models confirmed the presence of these lineaments and delineated intrusives within Sokoto Basin. This study concluded that the drainage system of north-western Nigeria is structurally controlled.

**Keywords** Sokoto Basin · Geologic structures · Rivers · Fault · Magnetism · Gravity

## Introduction

The most prominent feature of geophysical interest in north-western Nigeria is the Sokoto Basin. Sokoto Basin (Fig. 1A), makes up the south-eastern section of the Iuilemenden Basin which stretches from Mali and west of Niger Republic through north of Benin Republic and northwest of Nigeria to the eastern region of Niger (Kogbe 1981; Obaje et al. 2020). The basin spans between longitudes 3° 30′–7° 00′ E and latitudes 10° 00′–14° 00′ E. The Sokoto Basin is mostly made up of

mild sloping plains that range in elevation from 250 to 400 m. Low mesas occasionally interrupt the plain; with the most prominent feature in the basin being the NNE–SSW trending Dange Scarp from which two major rivers take their source (Obaje 2011; Nwajide 2013). The escarpment is directly tied to the basin's geology and has been heavily eroded through time, rendering it unrecognizable (Udoh 1970; Kogbe 1981). To the east and south, the basin is underlain by Precambrian basement (igneous and metamorphic) rocks while to the north, in the Tassaili and Hogar Mountains, it is underlain by Cambrian beds (Nwankwo AND Shehu 2015).

The north-western region of Nigeria houses several rivers whose drainage network may have been influenced by the original slope and structure of the ground surface and/or structural controls such as faults, fractures or joints (Zernitz 1932; Ehirim and Ebeniro 2005). Within the basin, River Sokoto—a tributary of the River Niger—serves as the prominent drainage (Holden and Green 1960; Chardon et al. 2016). Likewise, River Sokoto has River Rima, River Zamfara and River, Ka as its major tributaries. West of Sokoto, River Sokoto connects with River Rima and extends towards the Republic of Niger. These tributaries flow down a gentle slope into River Sokoto and flow southward into

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