obtained in November have 2–4 times more azadirachtin A than those obtained in July. Thus, emphasis should be given to identify genotypes of neem that will give fruits in November, rather than in rainy season. These seeds will also be less infected with fungi that deteriorate the quality of seeds.

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Modelling of a magnetic anomaly in east Ganga basin and its implications on the tectonics of the region

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Magnetic data around Muzaffarpur in the eastern part of the Ganga basin display a conspicuous magnetic anomaly in an otherwise relatively smooth magnetic terrain. The anomaly with intense amplitude of about 1500 nT is located at the junction of the west Patna Fault and the Sitamarhi Fault. The low–high axis of this anomaly is oriented at 45°E, suggesting that the source possesses remanent magnetism. Magnetic modelling reveals that the source, located at a depth of 4200 m, is polarized at an inclination of 10°S and declination of 45°E. This implies that the causative source is emplaced when this part of the continent is located 5° south of the equator and is tilted 50°E with respect to the present position, describing a moment of the northward journey of the Indian plate after its break-up from Antarctica.

Keywords: Aeromagnetics, magnetic anomaly, remanent magnetism, tectomics.

THE Ganga basin occupying a vast area of about 300,000 km^2 in the northern part of India is bounded by the Himalayas in the north and the Aravallis in the west. The Vindhyans and the Bundelkhand granite delimit its boundary to the south, whereas the Chota Nagpur Plateau serves as its eastern boundary. As the entire area is covered under a thick blanket of alluvium, the subsurface geology[1] (Figure 1) was inferred from geophysical data and drilling. The area was covered by airborne magnetic surveys[2–4], and ground magnetic, gravity and seismic surveys[5–8]. The geophysical data over the Ganga basin was interpreted in detail in terms of subsurface structures[2,3,6,7].

Although the magnetic anomalies over a thick sedimentary sequence of the Ganga basin are expected to display gentle gradients, data in the eastern part of the basin north of Muzaffarpur exhibit intense anomalies. The vertical magnetic intensity map[4,5] (Figure 2) of this area shows intense anomalies (marked A and B) of about 1500 nT, spreading over an area of about 30 × 40 sq. km. Although both the anomalies appear to be similar, data coverage of anomaly B is sparse and hence only anomaly A is used in modelling and interpretation as described in the following.

For magnetic modelling, it is essential to know the nature of magnetic anomalies which depend not only on

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the shape and size characteristics of the source, but also on the strike, dip and direction of magnetization. A guide to these variations has been provided by Gay [9,10], Reford[11] and Vacquier *et al.*[12]. In the study area, the inclination and declination of the earth's magnetic field are 38°N and –0.7°W respectively. Anomaly A resembles that of a vertical prism[13,14]. For normal induction, the induced magnetic anomaly (vertical intensity) over a vertical prismatic source will be as shown in Figure 3 *a*. The anomaly is a dominant high with a feeble low towards the north. For the observed anomaly, the low–high components are approximately equal and the axis of orientation of the low–high pair is along NE–SW. This situation is unusual and a clear indication of the presence of remanance. The angle made by the line joining the low–high (also known as the principal profile) with the north is approximately equal to the declination of the resultant magnetic vector[14]. To find the depth, width and other parameters of the causative source, the principal magnetic profile along SW–NE shown in Figure 2 was analysed using MAGMOD inversion program[15]. The results of the interpretation are given in Table 1. The observed and model data along this profile are shown in Figure 4.

Model magnetic anomalies for a vertical prism are computed on a *x*, *y* grid with the model parameters. A good match between the theoretical (Figure 3 *c*) and the observed (Figure 3 *d*) anomalies is obtained when the inclination and declination of the polarization vector are 10°S and 50°E respectively.

The following inferences can be made from modelling of this magnetic anomaly:

(i) From the susceptibility value (0.01 cgs), the causative source might be thought of as a mafic–ultramafic body.
(ii) The depth of 4200 m to the top of the causative source is in close agreement with the basement depth map published by the Geological Survey of India[3,16] and therefore, this intrusive appears to be at the basement level.

Table 1. Results of the interpretation of the magnetic profile across anomaly A using MAGMOD

Parameter	Result
Inclination of the earth's field	38°N
Declination of the earth's field	–0.7°W
Inclination of the polarization vector	10°S
Declination of the polarization vector	50°E
Depth to the top of the prism	4200 m
Half-width of the prism	16500 m
Half-length of the prism	18000 m
Magnetization intensity	490 cgs
Magnetic susceptibility	0.01 cgs

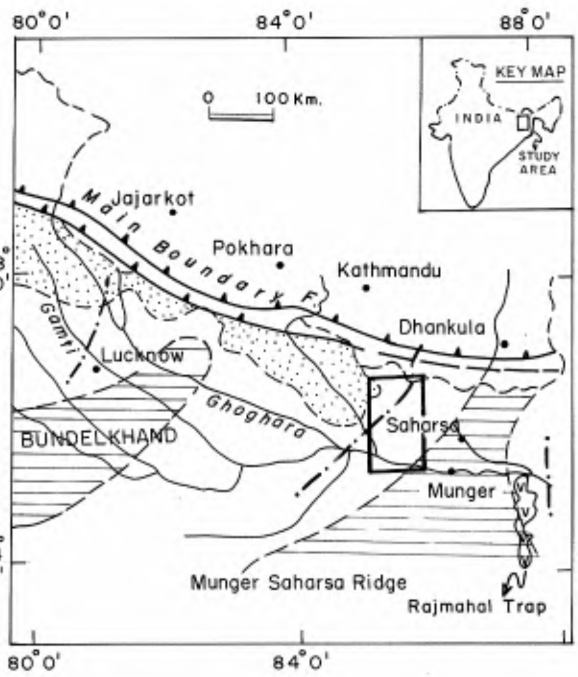

Figure 1. Basement structure of the Ganga basin (after Valdiya[1]).

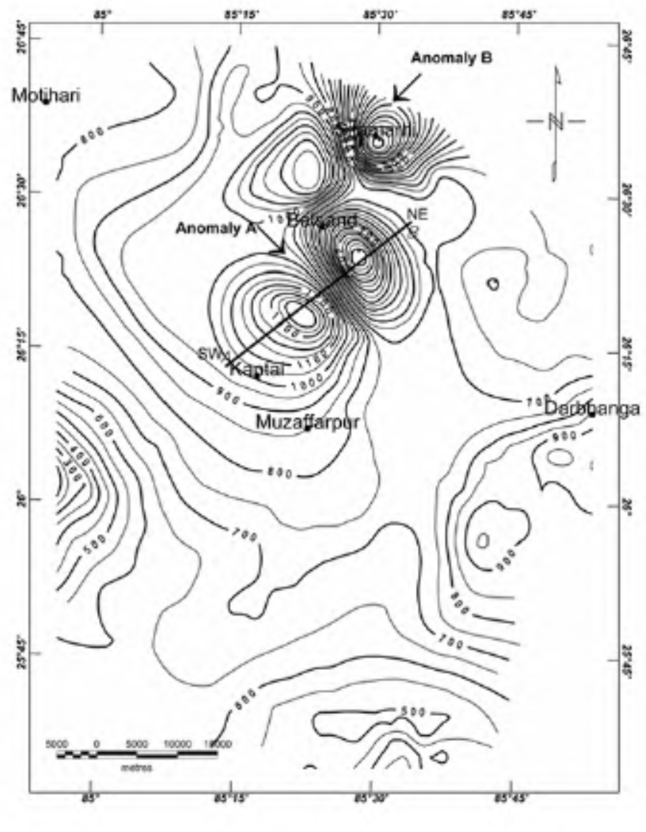

Figure 2. Vertical magnetic intensity anomaly map of Muzaffarpur area and its surroundings, in the eastern part of the Ganga basin. The map displays intense anomalies (A and B) north of Muzaffarpur. The SW–NE profile across anomaly A is used for interpretation.

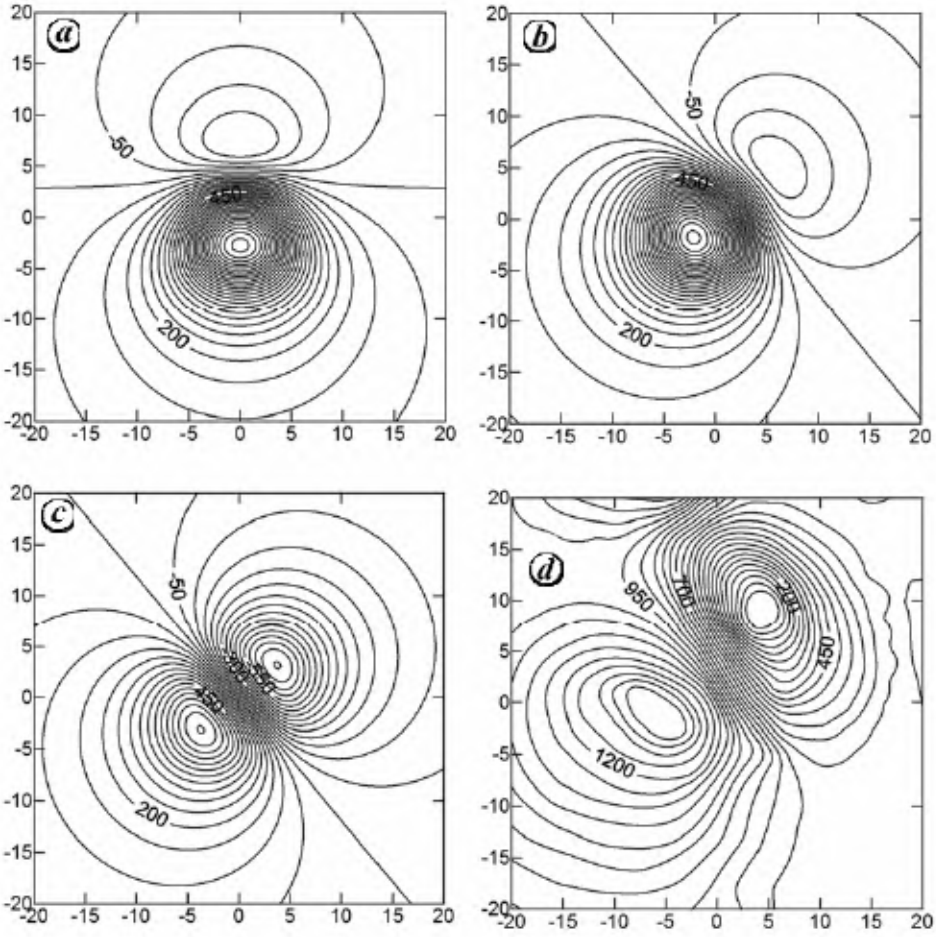

Figure 3. Model magnetic (vertical intensity) anomaly (***a***) over a prismatic source for normal induction; (***b***) remanently magnetized source at the same inclination but with a declination of 45°E; (***c***) remanently magnetized source with an inclination of 0° and declination of 50°E, and (***d***) field anomaly resembling that of (***c***).

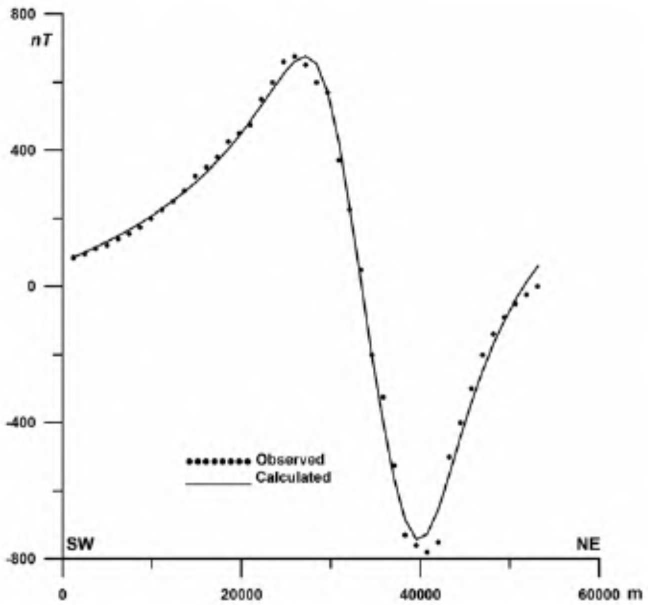

Figure 4. Modelling of magnetic anomaly along the profile AB shown in Figure 2.

(iii) The palaeo-latitude for 10°S inclination is 5°S. This implies that the geographic latitude of this place at the time of emplacement of this source was 5°S. The declination of 50°E suggests that the present N–S magnetic axis of this region was oriented at 50°E at the time of emplacement.

The structure and tectonic map of this region (Figure 5) shows three prominent faults at the basement level in this region[16,17]. The inferred magnetic source is located close to the junction of the west Patna Fault and the Sitamarhi Fault. The aeromagnetic anomaly map of Agocs[2] also shows several intense anomalies north of Muzaffarpur. This is suggestive of widespread intrusive activity in this region. Incidentally, the geographic longitude of this belt is close to 85°E, which may suggest that this igneous activity might be an imprint of 85°E ridge. Further east of this area, extensive igneous activity could be observed in the form of Rajmahal traps (Figure 1), which are thought to be a trace of the Crozet hotspot[18,19]. Based on the palaeo-latitude inferred from the present analysis, and the

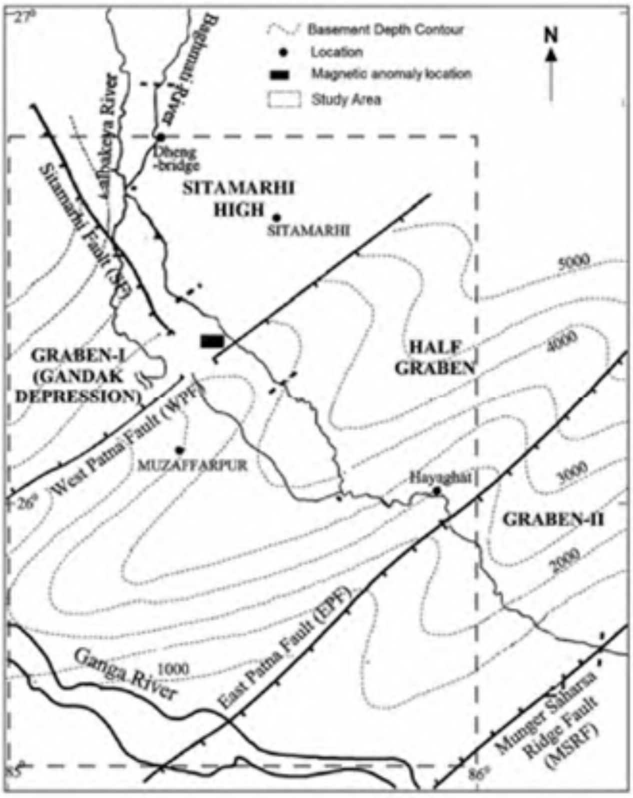

Figure 5. Tectonic elements of the study area (after Narula *et al.*[16]). The magnetic source is seen to be at the junction of the west Patna Fault and the Sitamarhi Fault.

age of the Rajmahal traps (117 Ma)[19], it may be interpreted that the igneous activity as inferred from magnetic anomalies might be contemporaneous with the Rajmahal volcanism.

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