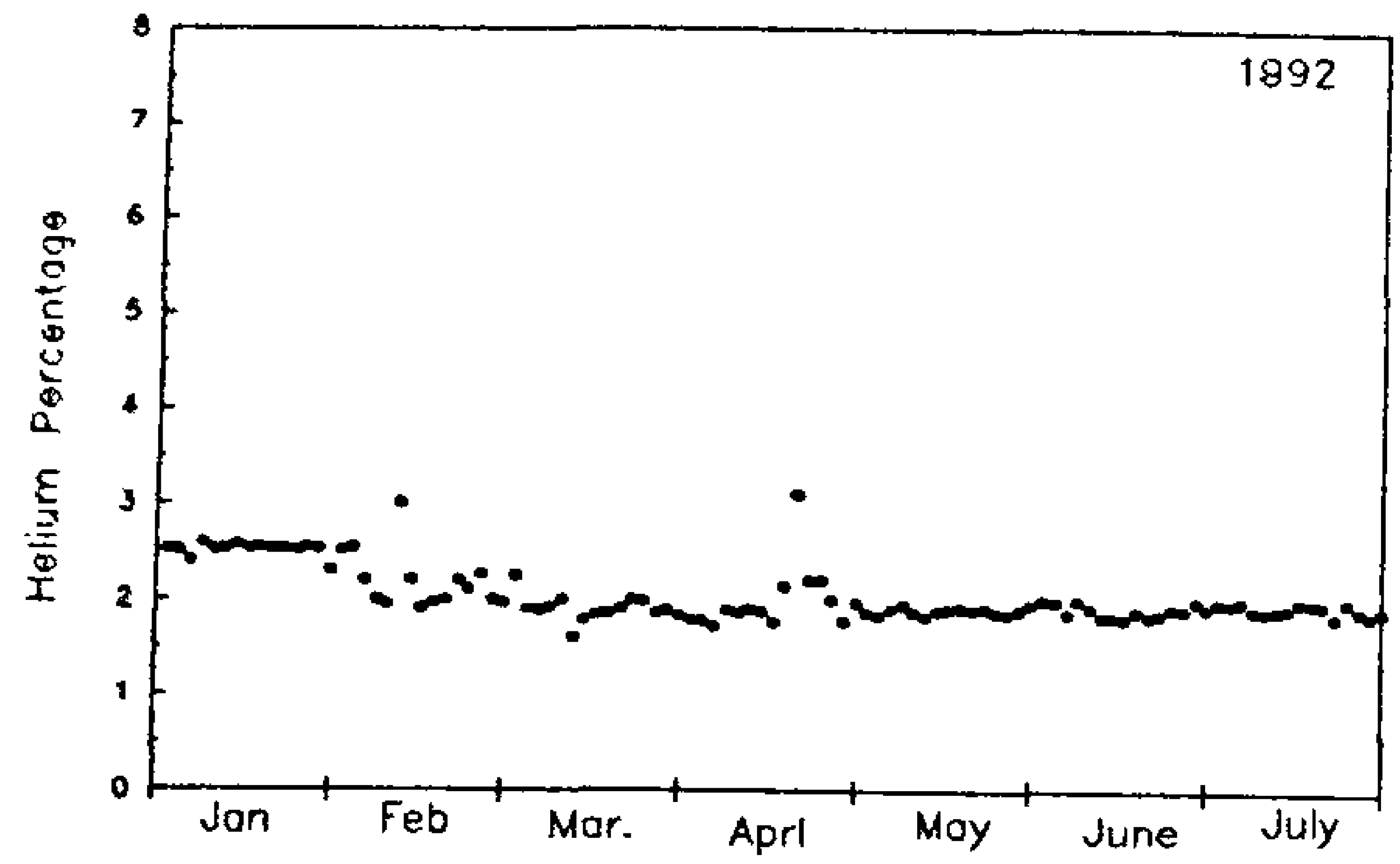

Figure 5. Temporal variations of helium in 1992 from January to July.

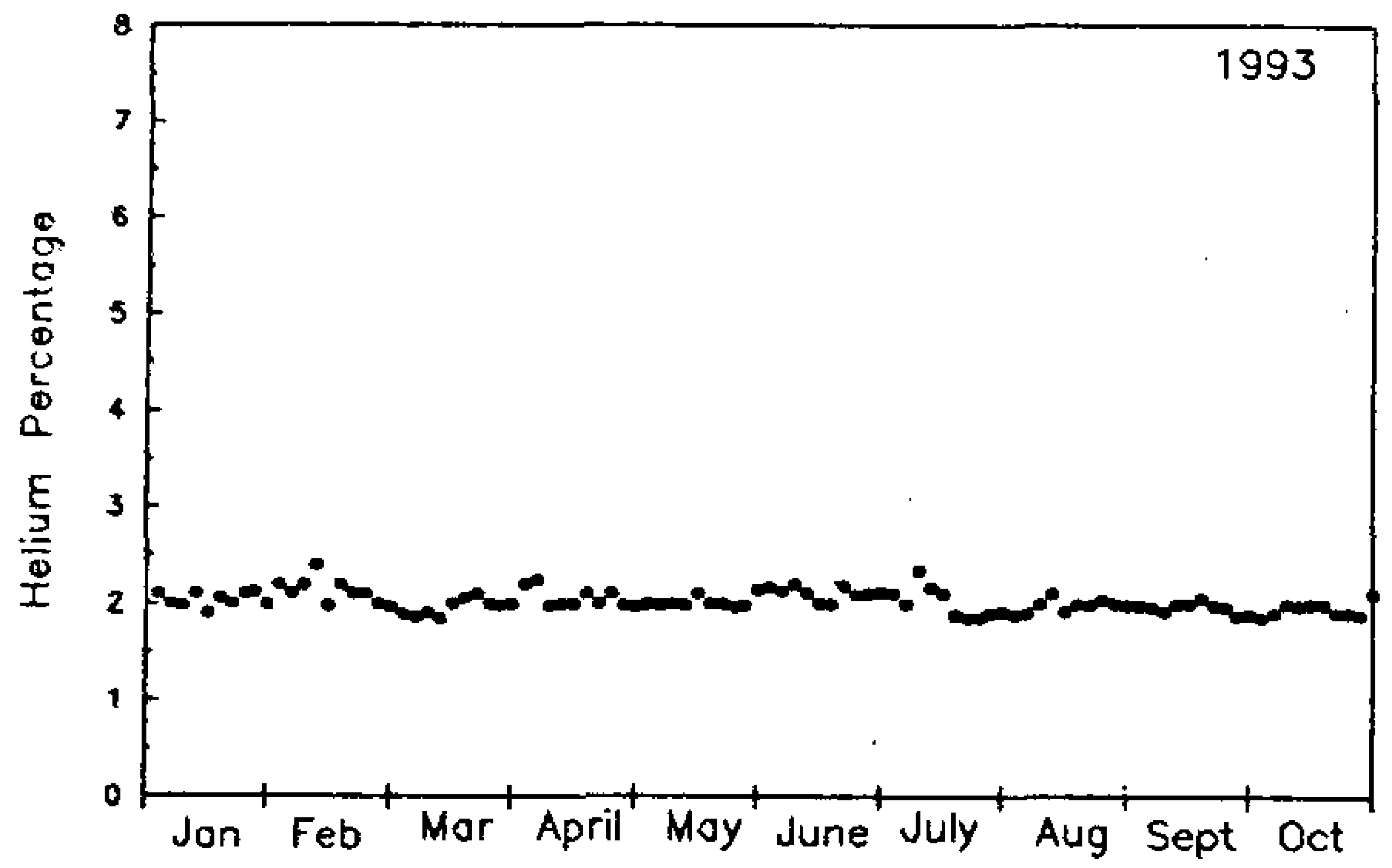

Figure 6. Temporal variations of helium in 1993 from January to October.

speculative, but interesting. Gradual accumulation of stress within the rock structure results in rise of pore pressure. The typical precursor of earthquakes, in general, is a steady rise in the pressure around the epicentre of the quake, at or around a yet unknown critical pressure of the system. Rather like more familiar phase transition of the system at a critical pressure essentially gives in with a sudden release of the pressure. With the rise of pressure the amplitude of the elastic shocks propagating around the centre increases as it approaches towards the triggering point. The shock waves, associated with the pressure release is the quake. With release of the pressure the helium stored in the rock matrix, aquifer or produced *in situ* tends to escape in larger volume as observed. The shocks travel a fairly large distance indeed, the very characteristic of helium is such that sources of helium turn out rather sensitive even at a very large distance. The speculative scenario, just prescribed has analogies with the bounce of supernova explosion or even head shocks or slide splash in nuclear physics[15,16]; a geological analogue in large scale is yet to be worked out.

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Modelling of aeromagnetic anomaly and its implication on age of emplacement of ultramafic–mafic–alkaline complex at Jasra, Assam

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The aeromagnetic anomaly around Jasra in Assam, based on which the Atomic Minerals Division had discovered an ultramafic–mafic–alkaline carbonatite complex[1] has been modelled. Inferred direction of magnetization of the source body suggested the age of emplacement of the source to be around Jurassic period which is correlated with the time of breaking up of the Gondawanaland and the northward drift of the Indian plate and crustal upheavals.

THE aeromagnetic survey carried out by the National Geophysical Research Institute (NGRI), over an area of about 14000 km^2, covering parts of Garo hills, Shillong plateau, and Khasi hills region of Meghalaya and Assam

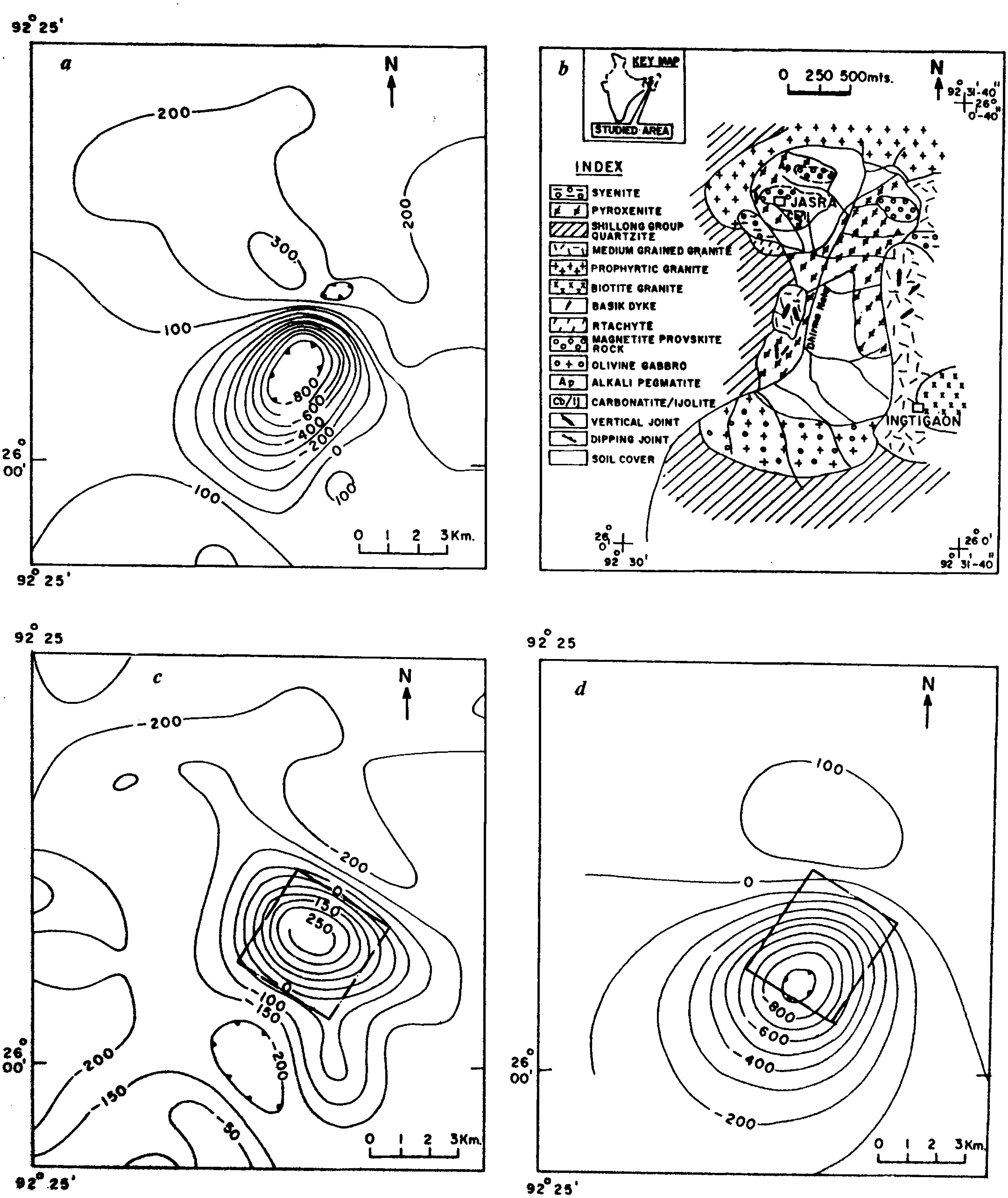

Figure 1 ***a–d***. ***a***, Aeromagnetic anomaly around Jasra; ***b***, geological map of Jasra area (after Mamallan *et al* [1]); ***c***, the complex gradient map of Figure 1 *a* showing the approximate boundaries of the source; and ***d***, model anomaly of the interpreted parameters.

has brought out a number of important magnetic anomalies and structures. The recommendations suggesting important locations for mineral exploration were submitted as a technical report[2] to the North Eastern Council (NEC). One of the important aeromagnetic anomalies recommended for ground followup is the region around Jasra in Assam for the possible occurrence of ultramafic suite of carbonatite/pyroxenite rocks similar to those occurring in the Sung valley. The survey was carried out with a rubidium vapour magnetometer, designed and fabricated by the NGRI, and this region was flown on lines spaced at one kilometer apart at an altitude of 1380 m above sea level. The aeromagnetic anomaly around Jasra (after removing the IGRF) recommended for ground follow up is shown in Figure 1 *a*.

Based on the clues provided by aeromagnetic data and Landsat-TM imagery, the ground follow up work by the geologists of the Atomic Minerals Division (AMD) led to the discovery of an ultramafic alkaline (carbonatite) complex at Jasra, Assam and was described as a new find[1]. This complex (Figure 1 *b*) consists dominantly of pyroxenites (with layers of titano-magnetite) with subordinate amounts of syenitic, alkali gabbroic bodies and very minor veins of ijolite, carbonatite and basic dikes. The pyroxenite body, together with other magnetizable minerals, produced an intense aeromagnetic anomaly described in the following.

The aeromagnetic anomaly associated with this complex shown in Figure 1 *a*, consists of a dominant low of about 800 nT amplitude with a small high on its northern side. The shape of the anomaly is not normal for this latitude for magnetization by induction and therefore suggests the presence of remanant magnetism in the source body. To infer the nature of the causative source and its magnetization, modelling of magnetic data has been done. The approximate outline of the source has been delineated from the 'complex gradient' map (Figure 1 *c*). The edges of the causative source appear as maxima on 'complex gradient' maps for wide and shallow sources; and for sources whose depth to top is roughly equal to the half-width, the half-maxima positions delineate the boundary of the source[3]. Modelling results indicated that the depth (1500 m below flight height) to the top of the source is roughly equal to the half-width of the source. Therefore, in the present case, the outline of the causative source is located at the half-maxima positions of the complex gradient map and is marked on Figure 1 *b*. Interpretation of the north–south principal profile by using the 3-D vertical prism model provided the depth to the top, width and the magnetization of the source. The model anomaly of the interpreted parameters is shown in Figure 1 *d*. The depth to the top of the source was inferred to be about 70 m below the ground surface. The dimensions of the source obtained from the modelling are 2.5×3.5 km and appear to be larger than the outcropping complex. This may be due to widening of the source at depth. The intensity of magnetization is about 500 nT. The direction of magnetization (I) of the source is obtained as $-63°$. This parameter can be used to calculate the palaeolatitude (λ) by using the standard relation $\tan(I) = 2\tan(\lambda)$. In the present case,

$$\tan(-63) = 2\tan\lambda$$

$$\therefore \lambda = -45° = 45°S .$$

The palaeolatitude of $-45°$ suggests that this part of the continent was located at 45° south latitude (i.e. in the southern hemisphere) at the time of emplacement of this intrusive source. The position of the north-eastern India at this latitude corresponds to the Jurrasic period[4] (125–175 my), which is in agreement with the reported ages[5] of 156 ± 16 Ma and 149 ± 5 Ma for the alkaline magmatism in this region and is correlated with the time of breaking up of Gondwanaland and northward drift of the Indian plate and crustal upheavals.

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