Interpretação -5

Tilt

Tilt

- Proposto por Miller & Singh (1994)
- O conceito é baseado na razão entre o gradiente vertical do campo e o gradiente horizontal do campo
- Utilidade das medidas: identificar a presença de lineamentos.
- Normalmente é representado em mapas de escala de cinza.

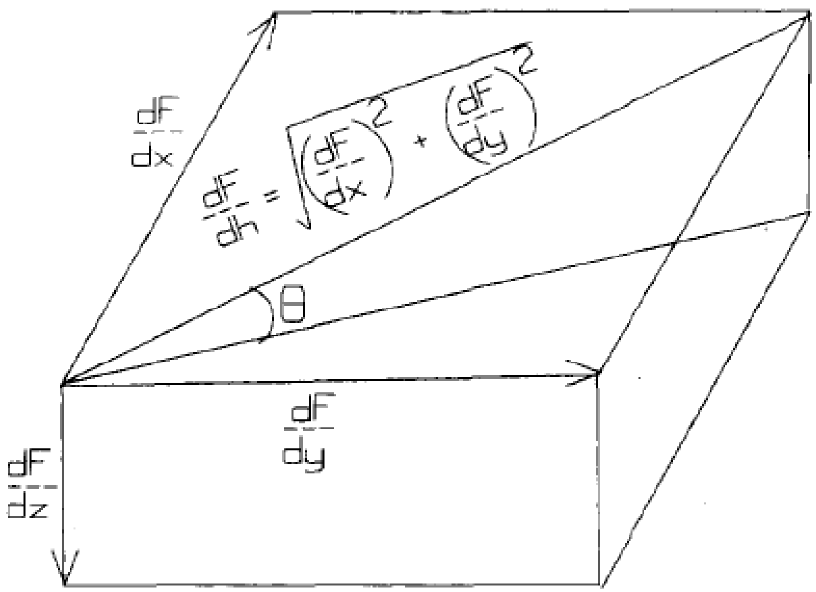


Fig. 1. Geometry used in defining the tilt Angle. df/dx = derivative of the field in the x-direction, df/dy = derivative in the y-direction, df/dz = derivative in the z-direction, df/dh = horizontal gradient of the field. Tilt angle, Θ, is measured relative to the horizontal.

$$\mathrm{TILT} = \tan^{-1}\frac{\text{vertical component of gradient}}{\text{horizontal component of gradient}}$$

$$= \tan^{-1}\frac{\left(\frac{\partial f}{\partial z}\right)}{\left(\frac{\partial f}{\partial h}\right)}$$

where:

$$\frac{\partial f}{\partial h} = \left[\left(\frac{\partial f}{\partial x}\right)^2 + \left(\frac{\partial f}{\partial y}\right)^2\right]^{1/2}$$

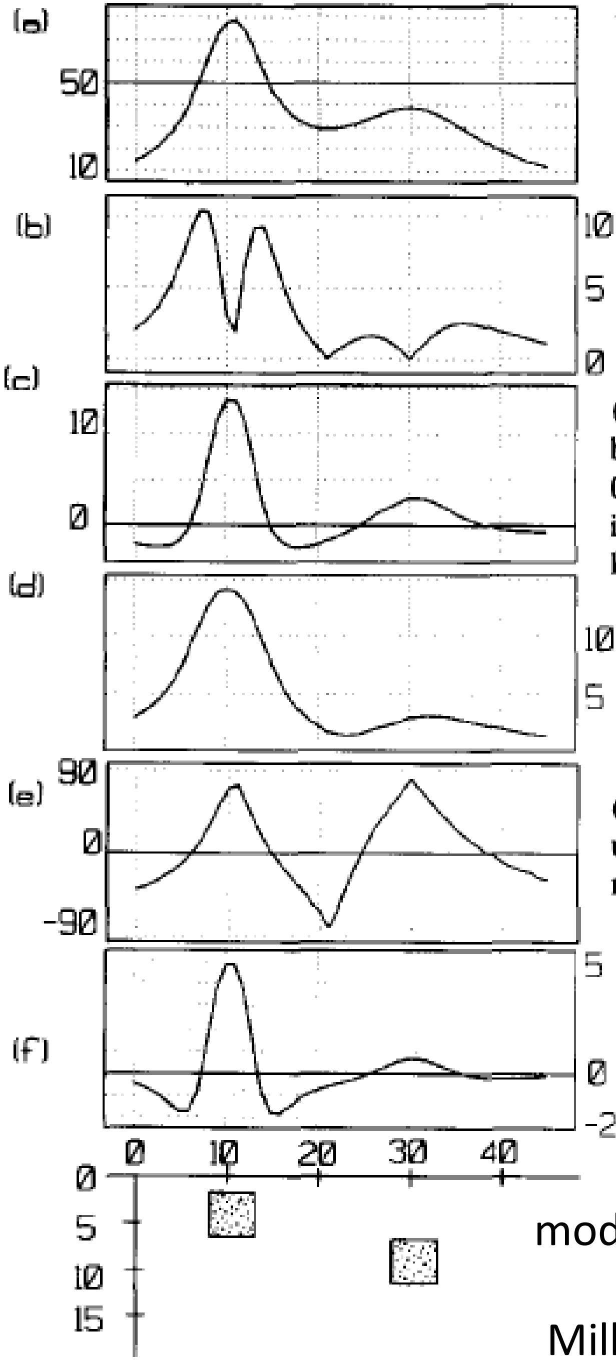


Fig. 2. (a) Gravity anomaly over two blocks, each of density contrast = 1, width = 5 km, thickness = 5 km. Block 1 extends from 8–13 km along the profile with top at 2 km depth. Block 2 extends from 28–33 km with top at 7 km depth. Gravity anomaly values in mGal computed every 1 km along profile.

(b) Absolute value of the horizontal derivative of profile in (a). Derivative computed from simple difference formula $df/dx = (f_{-1} - f_{+1})/2$ applied to 1 km spaced data of (a). Calculation performed every 1 km along profile; units mGal/km.

(c) First vertical derivative of data in (a) calculated by using same blocks as in (a) with depths to top and bottom of each increased by 0.1 km. Differences determined between this and anomaly calculated in (a). Calculation performed every 1 km along profile; units mGal/km.

(d) Analytical signal as defined by Roest et al. (1992) computed using data from (b) and (c). Units mGal/km.

(e) Tilt angle as defined in text computed every 1 km along profile using data from (b) and (c). Tilt angles are computed in degrees, maximum +90°, mimimum −90°.

(f) Second vertical derivative for data in (a) computed using the negative of the second horizontal derivative and the simple difference formula applied to the data of (b). Calculation undertaken every 1 km along the profile; units mGal/km^2.

modelo

Miller & Singh (1994)

$$\tan^{-1}\frac{\left(\frac{\partial f}{\partial z}\right)}{\left(\frac{\partial f}{\partial h}\right)}$$

where:

$$\frac{\partial f}{\partial h} = \left[\left(\frac{\partial f}{\partial x}\right)^2 + \left(\frac{\partial f}{\partial y}\right)^2\right]^{1/2}$$

Tilt

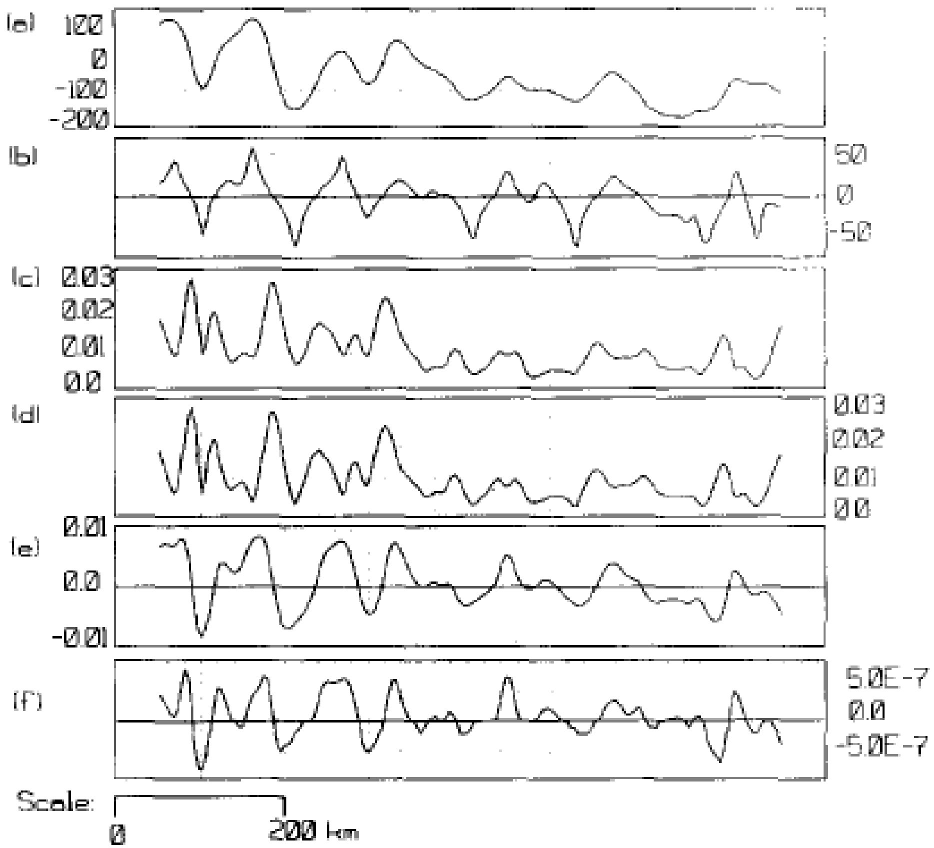


Fig. 3. Magnetic data along a profile from eastern Canada at a digitizing interval of 5 km. Profile location shown in Fig. 4. Horizontal axis provides indication of distance along profile in km. All data shown in (a)–(e) are extracted from appropriate maps of the area (Miller and Singh, 1993b). (a) Total field magnetic anomaly in nT. (b) Tilt angle for data in (a). Tilt angles in degrees. (c) Analytic signal for data in (a) in units nT/m. (d) Horizontal gradient for data in (a) in units nT/m. (e) First vertical derivative for data in (a) in units nT/m. (f) Second vertical derivative for data in (a) in units nT/m^2.

Miller & Singh (1994)

The complex analytic signal for 2D structures is

$$A(x,z) = |A|\exp(j\theta)$$

where $|A| = \sqrt{\left(\frac{\partial T}{\partial x}\right)^2 + \left(\frac{\partial T}{\partial z}\right)^2}$ is known as analytic signal (AS), T is the magnitude of the total magnetic intensity (TMI), and $\theta = \tan^{-1}\left[\frac{\partial T}{\partial z} \Big/ \frac{\partial T}{\partial x}\right]$ is the local phase.

The tilt derivative is similar to the local phase, but uses the absolute value of the horizontal derivative in the denominator

$$TDR = \tan^{-1}\left[\frac{VDR}{THDR}\right]$$

where VDR and THDR are the first vertical and total horizontal derivatives, respectively, of the TMI. While VDR can be positive or negative, THDR is always positive. For profiles in the x direction,

$$THDR = \sqrt{\left(\frac{\partial T}{\partial x}\right)^2}$$

and for grids

$$THDR = \sqrt{\left(\frac{\partial T}{\partial x}\right)^2 + \left(\frac{\partial T}{\partial y}\right)^2}.$$

Due to the nature of the arctan trigonometric function, all amplitudes are restricted to values between $+\pi/2$ and $-\pi/2$ (+90° and -90°) regardless of the amplitudes of VDR or THDR. This fact makes this relationship function like an automatic gain control (AGC) filter and tends to equalize the amplitude output of TMI anomalies across a grid or along a profile.

The total horizontal derivative of TDR is

$$TDR\_THDR = \left|\frac{\partial TDR}{\partial x}\right|$$

for a profile and

$$TDR\_THDR = \sqrt{\left(\frac{\partial TDR}{\partial x}\right)^2 + \left(\frac{\partial TDR}{\partial y}\right)^2}$$

for a grid. These are equivalent to the absolute value of the local wavenumber.

tilt

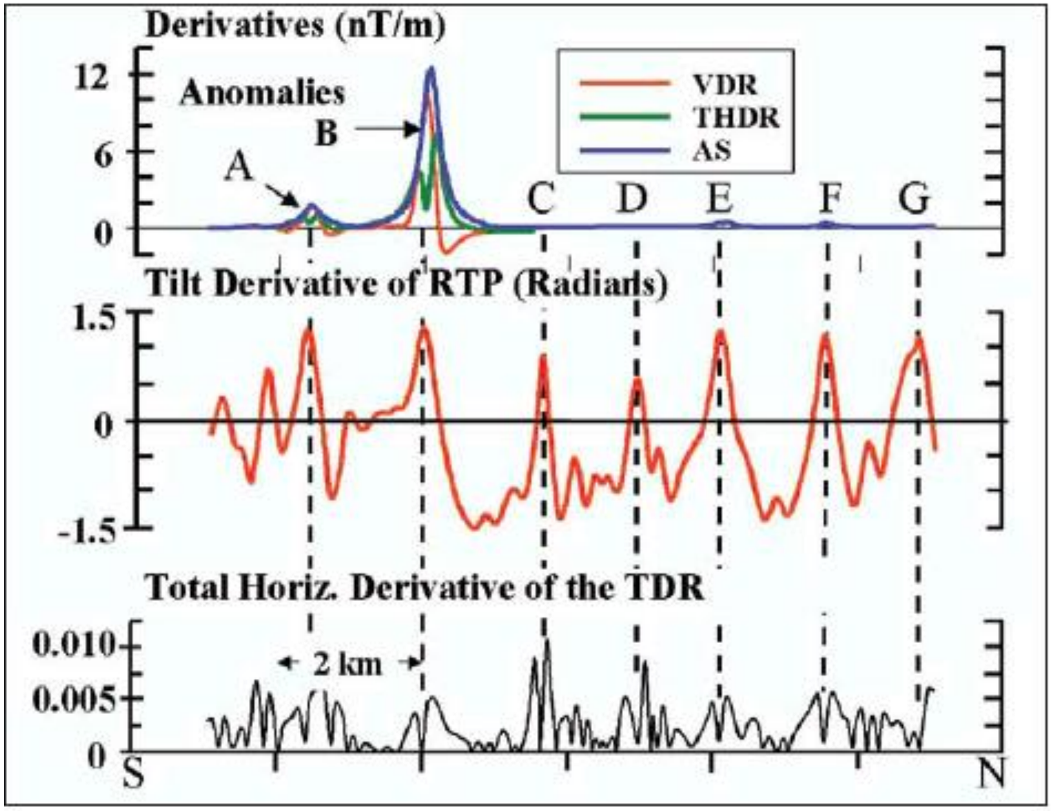


Figure 2. Profile P1 (for location see Figure 3D) comparing the response of common derivatives to both the tilt and total horizontal derivative of the TDR.

Verduzco et al., 2004

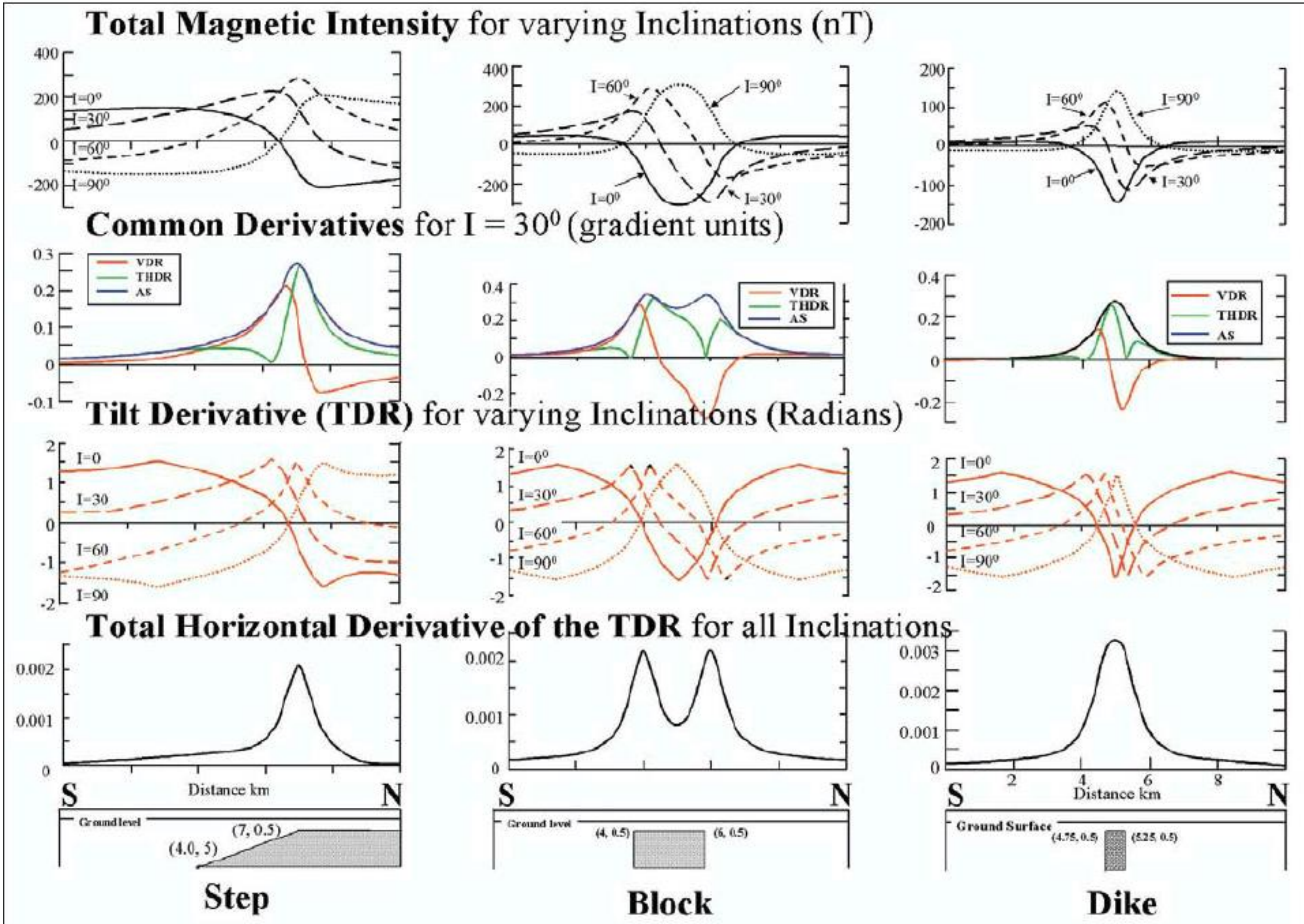


Figure 1. Magnetic responses along S-N profiles across W-E striking 2D step, block, and dike models.

Verduzco et al., 2004

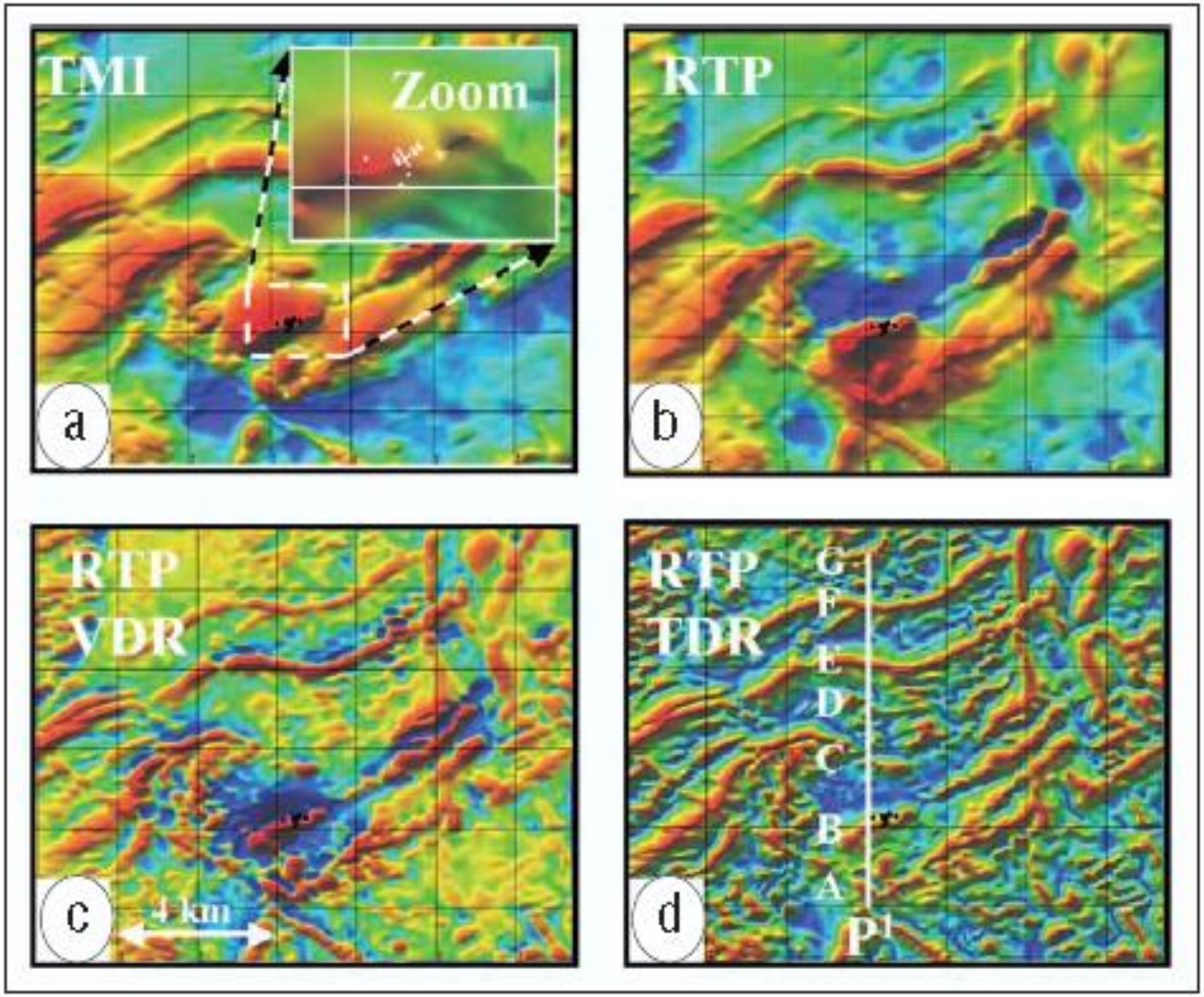
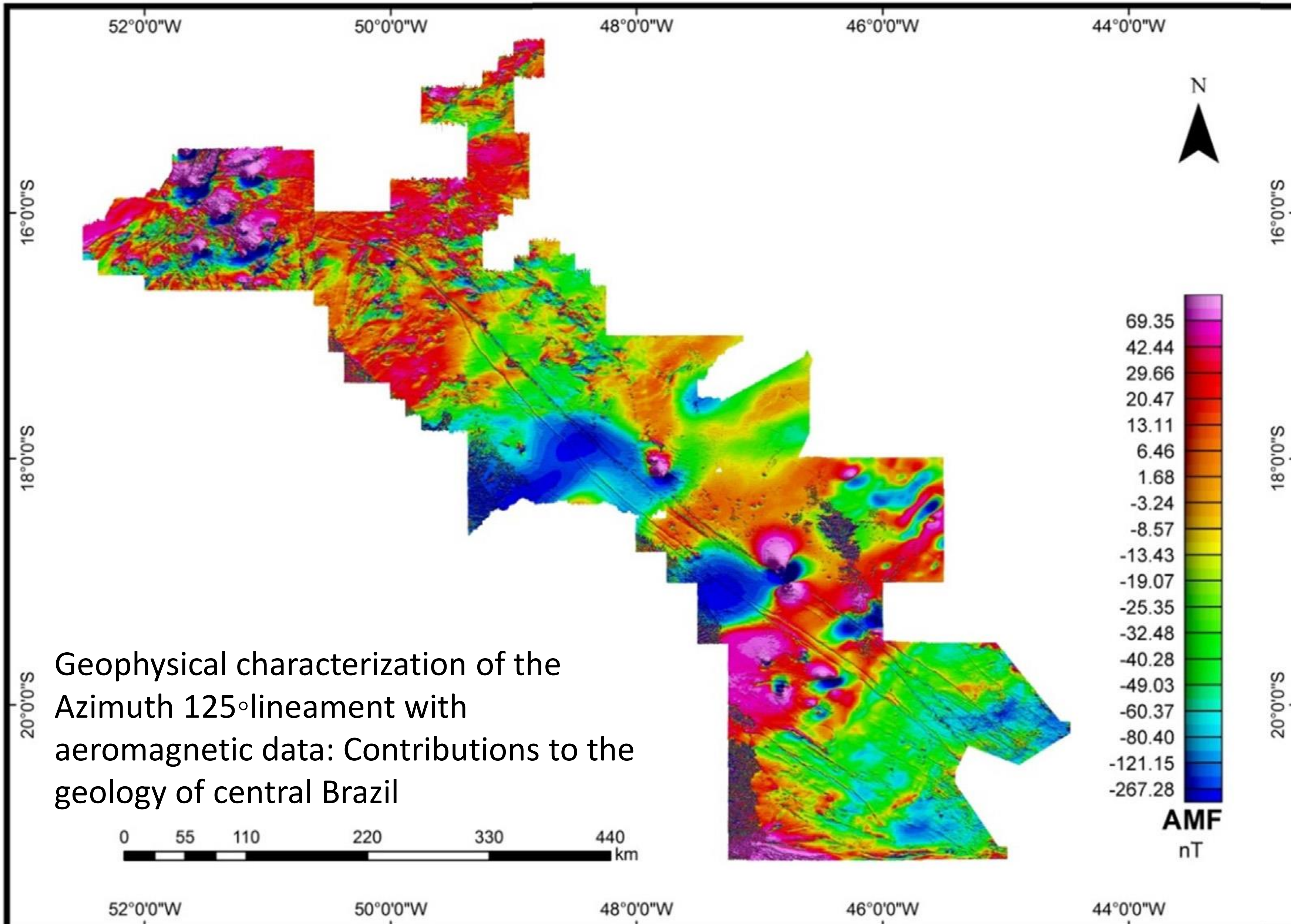


Figure 3. Color-equalized images (red high, blue low) for (a) total magnetic intensity, (b) reduced-to-pole, (c) vertical derivative of the RTP and (d) tilt derivative of the RTP.

Verduzco et al., 2004

http://dx.doi.org/10.1016/j.precamres.2014.05.005

Fig. 5. Anomalous Magnetic Field (AMF) image.



Geophysical characterization of the Azimuth 125◦lineament with aeromagnetic data: Contributions to the geology of central Brazil

Fig. 4. Location of the alkaline provinces and the ages of some of the associated intrusive bodies in the Analytical Signal Amplitude geophysical image.

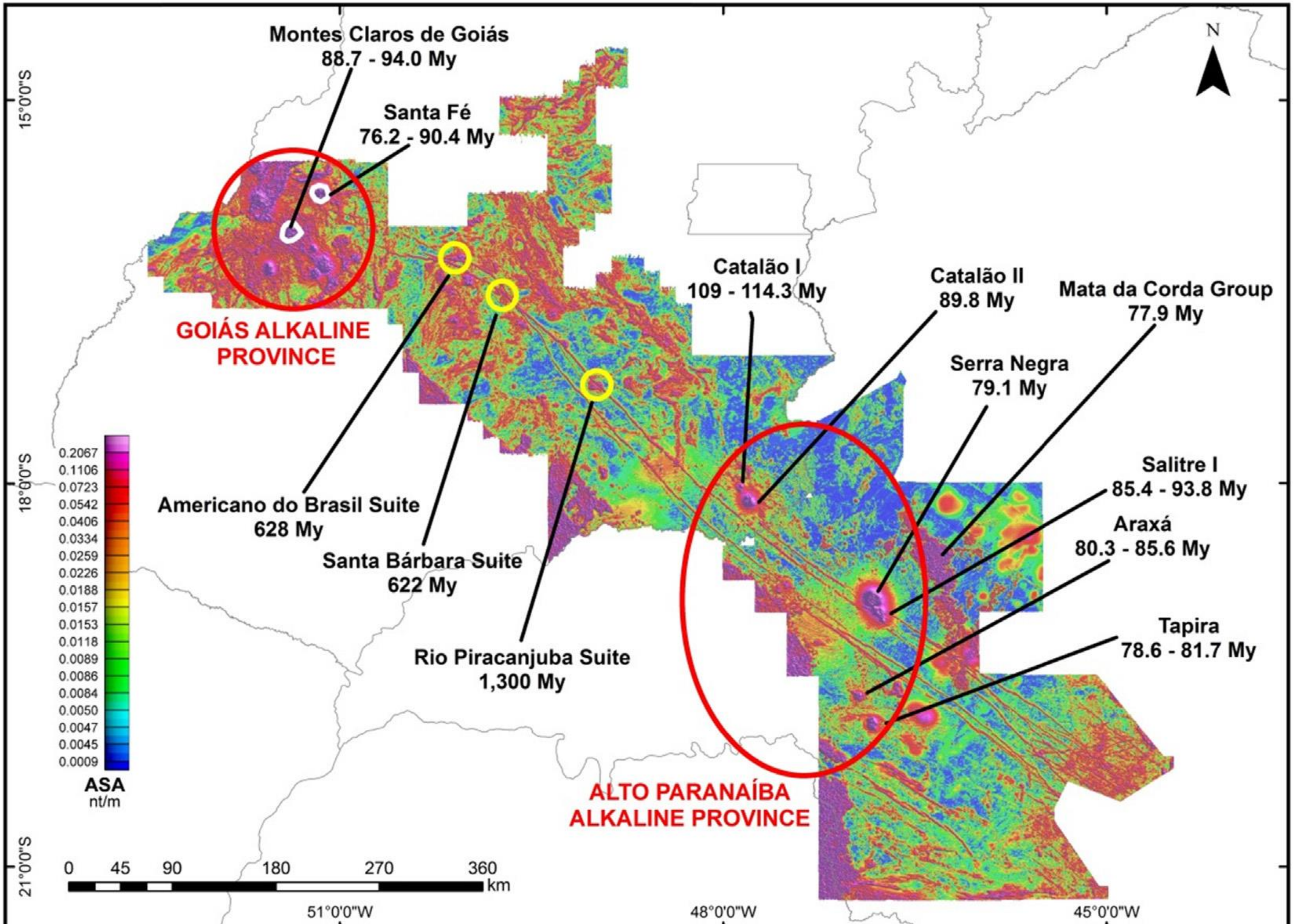
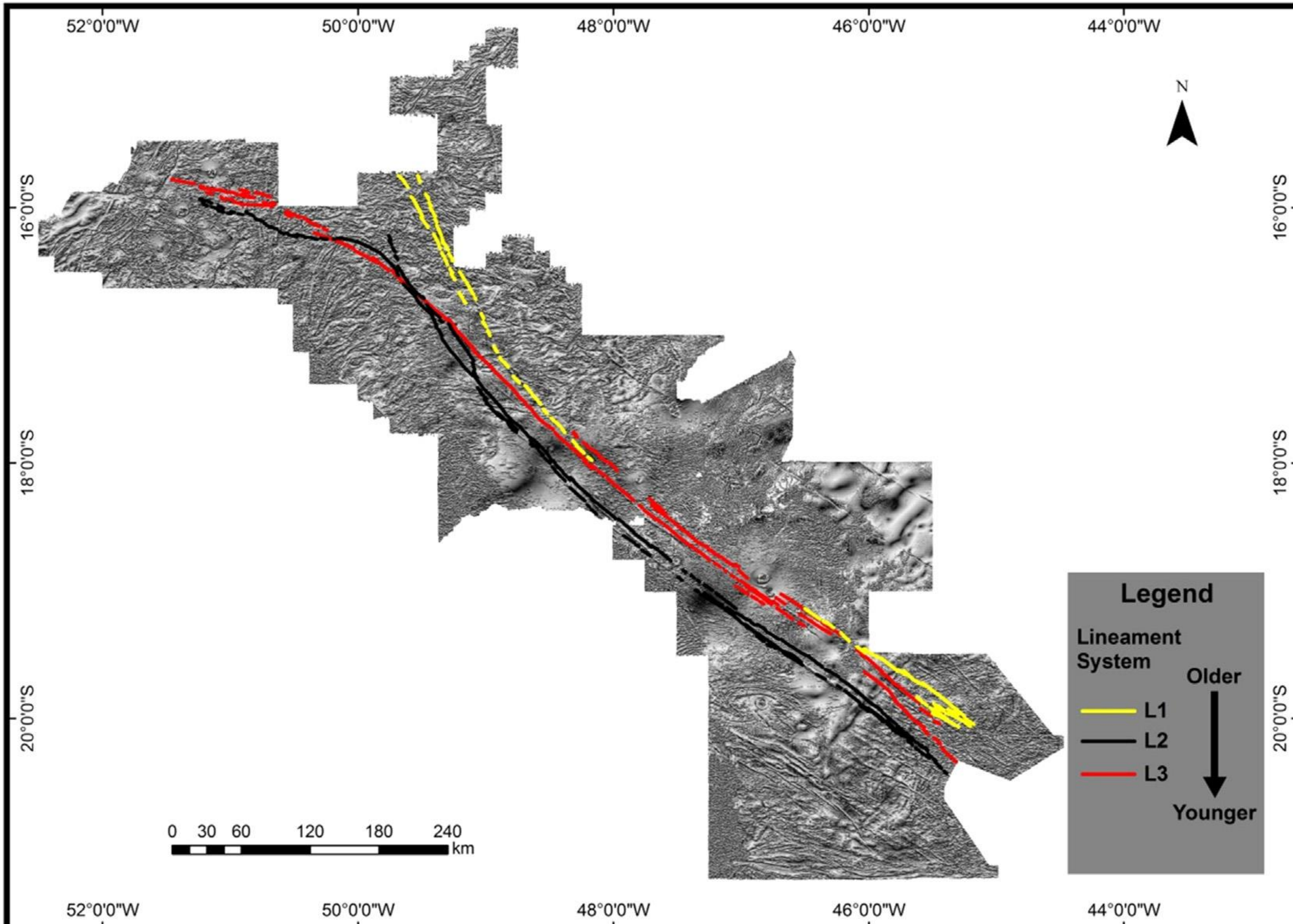


Fig. 6. Geophysical interpretation of the lineament systems for Az 125◦in the TILT image: L3 in red; L2 in black; and L1 in yellow.



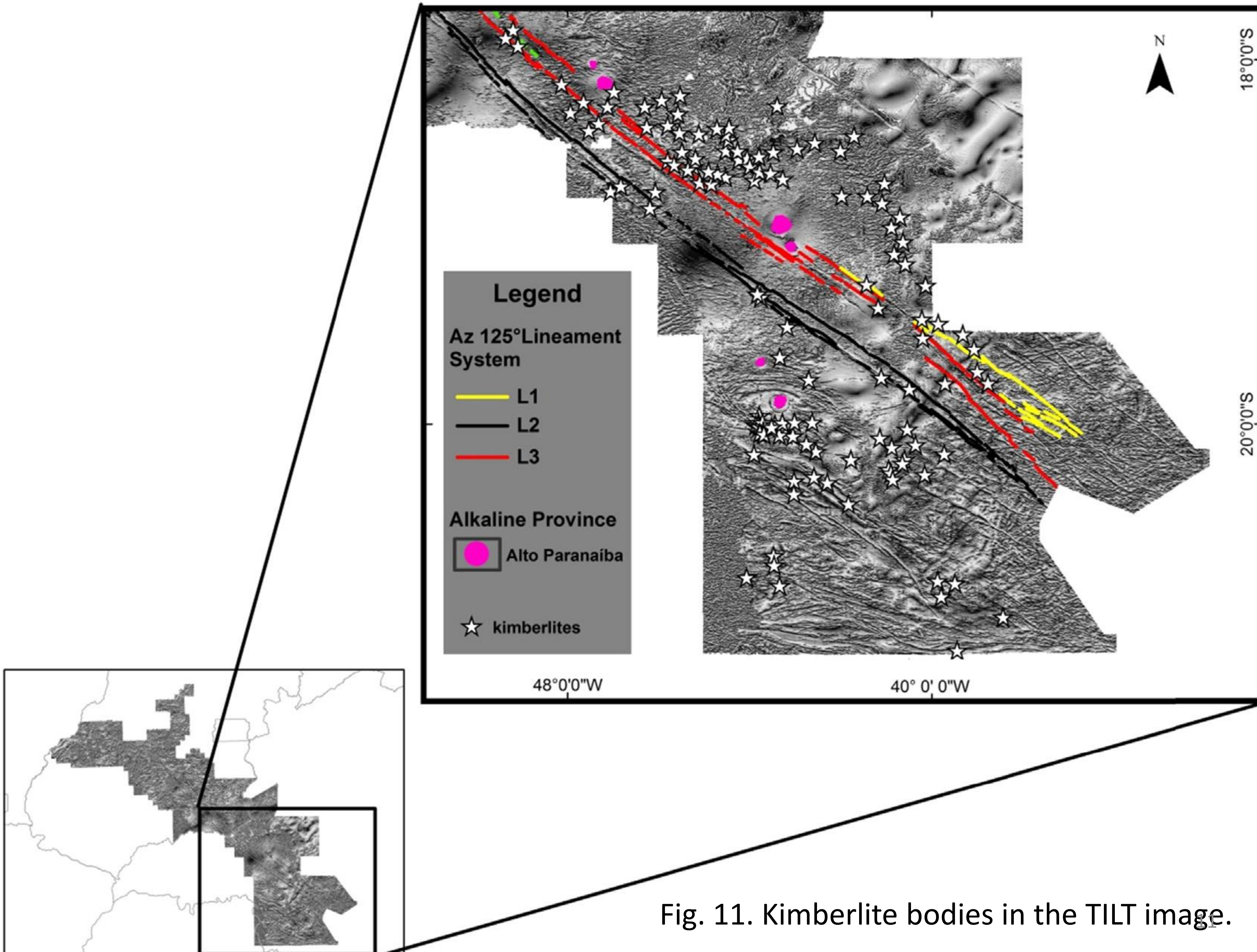


Fig. 11. Kimberlite bodies in the TILT image.