



To Magnetic Mentor Readers

From Dave Pratt

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Subject **Magnetic Mentor #2 Monochrome imaging - data and information**


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Summary

I have compiled the datasets that were used in the production of the ASEG Preview article Magnetic Mentor #2 Monochrome imaging August 2025. And they are available at the Tensor Research website at:

<https://www.tensor-research.com.au/magnetic-mentor/>.



Magnetic Mentor #2 Monochrome imaging
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The first Magnetic Mentor article focused on colour in magnetic imaging and I want to extend the discussion to the role of uncoloured monochrome images and their usefulness for the perception of depth changes and magnetic remanence detection. In both cases, the magnetic field attributes that you want to highlight have a relatively low dynamic range compared with the magnetic field.

Make sure you read the latest book from CSIRO written by Schmidt P, Austin J, Clark D, Lister K, Lister M, Fox C (2025) and titled *Exploration Magnetism: Theory and Practice*. This is a collection of articles that you can purchase as a book or download the free digital version. In the Magnetic Mentor series, I will reference and link individual chapters for further reading.

Depth perception

Relative basement depth changes can be inferred in magnetic images by changes in smoothness of edges caused by geological boundaries or narrow linear formations. It is analogous to a cloudy pond covering rocks where the deeper rocks look less distinct than those near the surface. Monochrome images enhance your perception of depth by using a clipped linear stretch. The limited dynamic range of monochrome lookup tables (LUTs) is well suited to enhancing depth perception, because depth variation typically has a limited dynamic range. The model generated image in Figure 2(a) was produced from steeply dipping magnetic formations truncated against a basement unconformable surface that is overlain by a half graben. This model was chosen to help you understand the depth-related changes that you can see in the Figure 2 images from the Cloncurry district in north-west Queensland. Here, the Cambrian age half graben is inferred by the depth changes, rather than direct detection. The change in smoothness is clearer for the first vertical derivative from (Fig. 3b) but also evident in the anomalous magnetic field. In Figure 2(c), the second vertical derivative produces a smooth dark grey region that closely maps the limits of the Cambrian basin.

Remanence perception

You can easily detect large remanently magnetised intrusions in colour images but monochrome images are very helpful in complex geological zones with overlapping anomalies. I attribute this benefit to the ease of recognising the local regional background context. An example from the diastatic escarpment region of Arnhem Land in the Northern Territory has been selected to illustrate complex magnetic reversals as well as depth variations.

The colour image (Fig. 3a) is included to illustrate perception differences between monochrome and colour. Figure 3(b) uses the C75 LUT monochrome lookup table and Figure 3(c) reverses the LUT direction. In this example, the region is divided into four zones by their magnetic character.

1. NNE trending, central, high amplitude shallow magnetic basement zone associated with the Milneburg Fault.
2. SE quadrant that links the part of a magpie leaf floating on water.
3. NW quadrant with NNE linear suite of anomalies.
4. Eastern side, NNE linear suite of dip-related anomalies.

Apart from the basement host block in Zone 1, the magnetic responses are dominated by the pervasive and remanently magnetised Cenozoic Dolerite (1720 Ma) which intrudes the Kunibidji Sandstone (2300 Ma) in a dip along with numerous dykes in the underlying sequence. The Arnhem Province basement rocks are overlain by the McArthur and Anjala basins and younger Cenozoic sediments.

Zone 2 is unusual in shape and not that common because the magpie leaf outline is caused by the truncation of the sill along the permozone, sub-vertical emplacement of the Kunibidji Sandstone. The dark blue colour along the north-south (Fig. 3a), brown arrow (Fig. 3b) is caused by a line on the northern facing off edge. In Figure 3(c), the colour table is reversed which makes the magpie leaf style anomaly look normally magnetised and easier to understand. Small, circular positive anomalies are most likely caused by thinning of the sill or weathering (three green arrows) and the other north-east pointing green arrow shows a high trend which is believed to be associated with one of the many narrow canyons that cuts the reversely magnetised sill. See Chapter 32 of *Exploration Magnetism: Theory and Practice* for more details on this topic.

The Zone 3 Cenozoic Dolerite dykes suggest similar depth to the sill on the western margin where they are covered by much younger Cenozoic sediments (< 60 Ma). As you move east, the depths appear to increase and may be related to deeper sections of the McArthur Basin or dykelets. Figure 3(d) shows basement rocks. The width and sharpness of the dyke anomalies is clear in the monochrome images. The south-east oriented cyan arrow indicates the direction of increasing depth which is more likely to be associated with the base of the McArthur Basin.

In Zone 4, a series of very narrow, normal and reversed anomalies trend in a north to north-west direction. I believe they are young, submerging dykes and unrelated to the Cenozoic Dolerite. The normally magnetised Zone 1 provides a clear separation with Zone 3.

I note that Clive Fisk is writing a series of articles on classic magnetic anomalies exhibiting remanence. His first *Freeview article on the Black Hill Norite* in South Australia covers a lot of interesting material on this remanent anomaly and the underlying rock properties.

Summary

- Uncoloured monochrome images are generally more effective than colour for emphasising depth-related smoothing of formation edges.
- The dynamic range of depth in most images is limited and well suited to monochrome visualisation.
- The regional background field is easier to recognise in monochrome images when searching for magnetic reversals.

Magnetic Mentor data access

A zip file containing the underlying data, lookup tables, useful references and government licence documentation is provided for each publication of the *Magnetic Mentor* series. The data eventually forms a foundation for a training resource for those of you that want to experiment further with the data and underlying ideas.

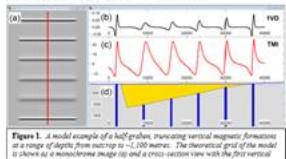


Figure 1. A model example of a half graben, showing vertical magnetic formations as a range of depths from 10 to 100 metres. The model is shown as a monochrome image (a) and a cross-section view with the first vertical derivative (b), anomalous magnetic field intensity (c), and model sections (d).

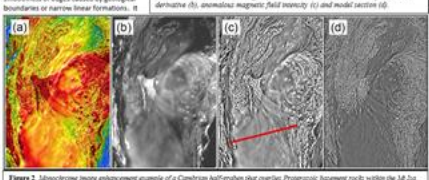


Figure 2. Monochrome image enhancement example of a Cambrian half graben that overlie Permozone basement rocks within the 18 Day Star. The image includes a linear colour stretch (C75-LUT) (a), reduction to the pole (C75) (b), first vertical derivative (C75) (c), and second vertical derivative (C75) (d). The red line in (c) highlights a section of the half graben that is equivalent to the model in Figure 1.

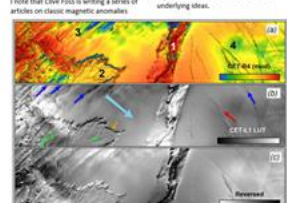


Figure 3. Colour and monochrome image comparisons from an Arnhem Land, NT magnetic survey. (a) Linear colour stretch for comparison with a monochrome image. (b) Linear colour stretch for comparison with a monochrome image. (c) Monochrome image with magnetic anomalies. (d) Monochrome image with magnetic anomalies. Coloured arrows highlight important remanence and depth features that are referred to in the text.

Draft view of Magnetic Mentor #2 Monochrome imaging,

Useful Links

When appropriate, files used in the preview series of the Magnetic Mentor are made available along with links to related information and publications.

Exploration Magnetism: Theory and Practice

<https://www.publish.csiro.au/book/8049>

Download link for Exploration Magnetism: Theory and Practice

<https://www.publish.csiro.au/ebook/download/pdf/8049>

Black Hill Norite – ASEG Preview

<https://www.aseg.org.au/public/200/files/digital-library-files/pv236.pdf#page=38>

Link to magnetic Mentor associated data files

<https://www.tensor-research.com.au/magnetic-mentor>

Reference to Creative Commons Licence introduction

<http://www.ga.gov.au/copyright>

Creative Commons Licence details

<https://creativecommons.org/licenses/by/4.0/>

Links from previous issues of the Magnetic Mentor

Centre for Exploration Targeting, WA

<https://www.cet.edu.au/>

Peter Kovesi – CET Perceptually Uniform Colour Maps

<https://colorcet.com/download/index.html>

Geoscience Australia data discovery and download

<https://portal.ga.gov.au/persona/gadds>

QLD Geological Survey download site

<https://geoscience.data.qld.gov.au/data/magnetic/mg001370>

South Australian Gawler Craton Survey (includes reports and processed results

<https://www.energymining.sa.gov.au/industry/geological-survey/gssa-projects/gawler-craton-airborne-survey>

Datasets

Data from the Queensland Geological Survey and Geoscience Australia were used in the production of the publication and subsets were produced by cutting the areas of interest out of larger grid areas. The project and datum information is stored in the associated ER Mapper sidecar ERS files.

The colour lookup tables used in the production of these images are also in ER Mapper LUT format and I used Discover PA for the production of the image captures. If you need these lookup tables in an alternative format, please email David.Pratt@tensor-research.com.au.

The model, model line and grid data used to produce the half-graben model simulation plus the ModelVision 18.0 session file are also included in a small Zip file.

File List

The file Magnetic Mentor 2.zip contains the following data files:

03/05/2018	12:02 AM	9,338	CET-L1.lut
03/05/2018	12:02 AM	9,338	CET-L2.lut
28/04/2025	01:07 PM	9,338	CET-R4.lut
28/04/2025	01:43 PM	4,422	CET-R4_DAP.lut
14/07/2025	11:25 AM	8,276,692	Half graben model.zip
25/05/2025	05:44 PM	5,421,536	RTP_MM-2 1VD Cloncurry
25/05/2025	05:44 PM	762	RTP_MM-2 1VD Cloncurry.ers
26/05/2025	12:48 AM	5,421,536	RTP_MM-2 2VD Cloncurry
26/05/2025	12:48 AM	762	RTP_MM-2 2VD Cloncurry.ers
25/05/2025	05:43 PM	5,421,536	RTP_MM-2 Cloncurry
25/05/2025	05:43 PM	769	RTP_MM-2 Cloncurry.ers
14/07/2025	11:40 AM	7,769,952	TMI_44m_Arnhem Land_132m
14/07/2025	11:40 AM	765	TMI_44m_Arnhem Land_132m.ers

Half graben model.zip

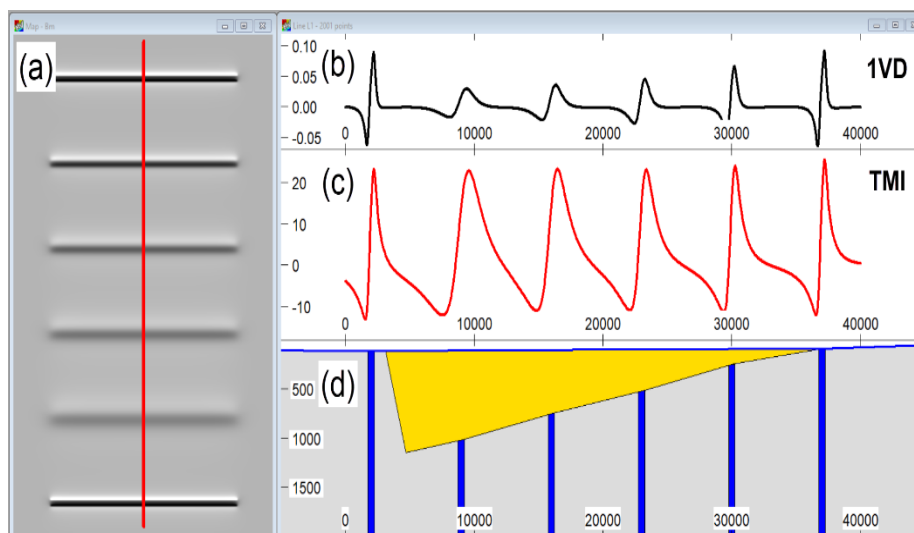


Figure 1. A model example of a half-graben, truncating vertical magnetic formations at a range of depths from outcrop to ~1,100 metres. The theoretical grid of the model is shown as a monochrome image (a) and a cross-section view with the first vertical derivative (b), anomalous magnetic field intensity (c) and model section (d).

The file **Half graben model.zip** contains the ModelVision 18 session files, plus exports of the TKM model file, model grid and model profile data.

Cloncurry

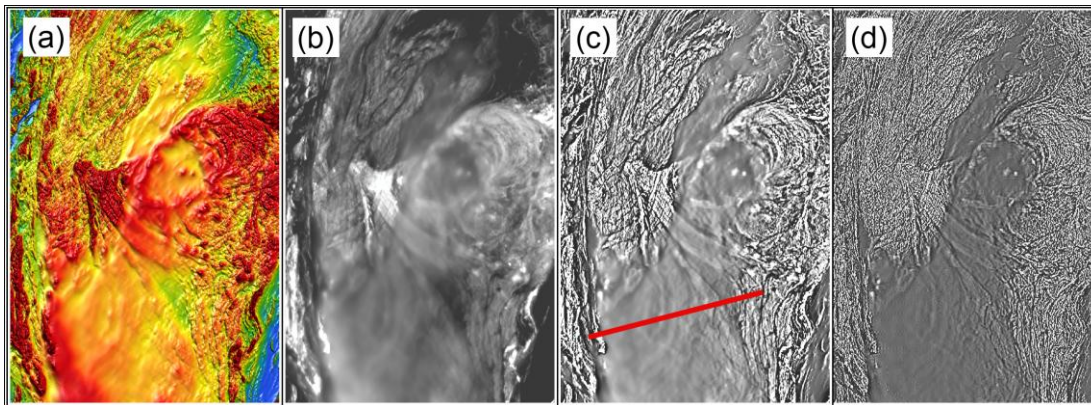


Image 2 from the Cloncurry region of QLD.

Arnhem Land

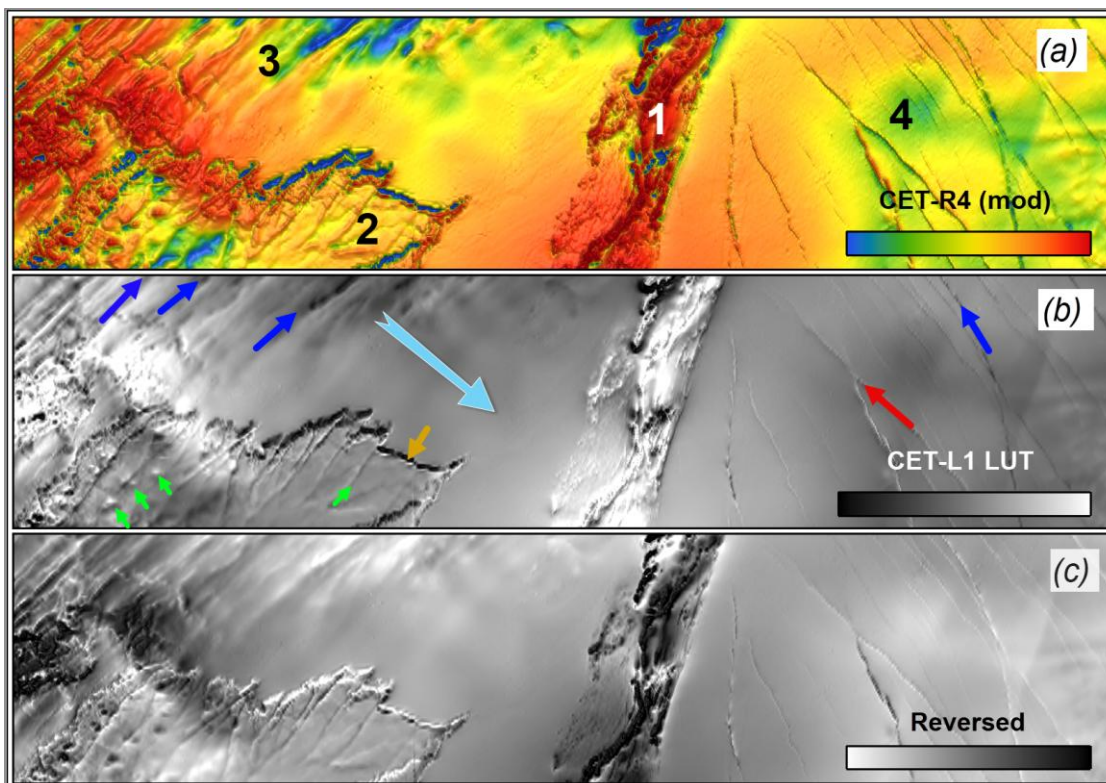


Image 3 from Arnhem Land data.

Note:

The grid **TMI_44m_Arnhem_Land_132m.ers** used to produce these images was subsampled from the original 44 metre download to 132 metres to save space. This resolution is sufficient to reproduce the images, but more detail is available on the GADDs download site.



Image of the Arnhem Land escarpment.

Data Sources

Cloncurry Regional data is provided by download from the Geological Survey of Queensland via their Open Data Portal:

[Cloncurry South \(GSQ\) - Cloncurry South \(GSQ\) - Magnetic - GSQ Open Data Portal](#)

The Northern Territory data is provided by download using Geoscience Australia's GADDs data portal:

[Geophysical Archive Data Delivery System](#)



Data Licence

Geophysical data supplied by the Queensland Government and Geoscience Australia is provided under a Creative Commons Licence which requires acknowledgment of the source of the data.

Reference to Creative Commons Licence introduction

<http://www.ga.gov.au/copyright>

Creative Commons Licence details

<https://creativecommons.org/licenses/by/4.0/>