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TECHNICAL NOTE

Subject: TargetMap™

1 Introduction

Many geological features produce weak or subtle responses in geophysical survey data. In addition, overburden such as the regolith, near-surface basalt, maghemite-rich surface paleo-drainage systems and surface cultural features usually produce strong geophysical responses which obliterate detail and obscure the response of the underlying geology. These situations are major challenges for explorers and are a challenge for data enhancement techniques in resolving the sub-surface geology.

Standard algorithms such as upward-continuation and low-pass filtering “smear” the data to resolve an “average” long wavelength response of the sub-surface geology. Whilst upward-continuation filtering produces a mathematically accurate depiction of the response at a higher survey level, there is a drastic loss of detail which is often important in understanding the sub-surface geology. These techniques, including high-pass filtering which is sometimes used to resolve detail in the near-surface, are also limited in their ability to detect linear and curvilinear features, particularly in the presence of a strong overburden response.

Derivative filters, such as vertical and horizontal derivatives, are commonly used to enhance detail and to delineate linear and curvilinear features. However, they produce complex (ie low-high-low and high-low-high) responses and distort the true polarity of features. They are also very sensitive to the overburden response and consequently are limited in their ability to resolve detail in large sub-surface features when an overburden is present.

TargetMap™ has proved to be a highly effective alternative for resolving a wide range of features in survey data, even in the presence of a strong overburden response.

2 TargetMap™ pattern recognition algorithm

TargetMap™ is a 2-dimensional pattern recognition algorithm developed by Vector Research to resolve detail in survey data and to “see” the sub-surface geology through the masking effects of overburden and cultural interference. It produces five (5) standard responses which **target** and **map**: linear and curvilinear features associated with structures, stratigraphy and edges of rock formations; subtle detail on linear and curvilinear features; near-surface features; and textures in an overburden. TargetMap™ can also “see through” the masking effects of overburden and cultural interference to **target** and **map** features in the underlying geology.

TargetMap™ can resolve deeply buried bodies through the overburden response and through the interfering effects of cultural features such as buildings and other infrastructure. It can resolve the true polarity of near-surface features and features located below an overburden, unlike the complex responses characteristic of derivative filters.

TargetMap™ can also delineate linear and curvilinear features in selected strike directions or over a range of strike. These are usually related to structures, fold axes, stratigraphy, bedding, and boundaries of rock formations. Often strong linear and curvilinear responses are associated with overburden features, for example paleo-drainage and fractures in surface basalt flows, which sometimes appear to be related to paleo-topography and structural features in the underlying geology. The linear and curvilinear features are

removed from the survey data to reveal “spot” anomalies lying on the linear and curvilinear features. These “spot” anomalies are usually related to either, variations in the dimensions of the linear and curvilinear features, or are associated with other anomalous sources located on the linear and curvilinear features. High-frequency “textural noise” is also revealed which can usually be correlated with the surface geology.

TargetMap™ operates on survey line data in preference to gridded data in order to preserve survey resolution. It includes a radial scan algorithm that looks for linear and curvilinear features over a specified range of strike across the survey lines. When there are several linear features passing through a location the algorithm outputs the amplitude of the strongest strike direction at that location, with consideration of wavelength. The linear and curvilinear features obtained from the radial scan are combined with other scans of the survey lines to compute all the TargetMap™ responses.

TargetMap’s filter resolution determines the minimum length of features that the filter detects when scanning the data. Increasing the filter resolution increases the resolution of longer (broader) features and wavelengths in the output responses. Long wavelengths are associated with broad near-surface features and, in magnetic and gravity data they can be attributed to deeper more compact features having higher density or higher magnetic susceptibility. Filter resolution (N) determines the number of survey lines scanned and ranges from one (1) to a maximum value that is limited by the size of the survey.

The minimum size of linear features resolved in the radial scan is equal to the filter resolution (N) multiplied by the average survey line spacing. For example, with survey line spacing of 100 metres, at resolution 1 features of less than one survey line spacing in size ie. 100 metres (1 x 100 metres), will not be resolved by the scan. For resolution 10, features of less than ten line spacings in size, ie. 1000 metres (10 x 100 metres), will not be resolved in the scan. TargetMap™ is usually applied with the four (4) standard resolutions (N) of 1, 3, 5 and 10.

TargetMap™ is highly effective in detecting and enhancing the responses of a wide variety of geological features and has been successfully applied to a variety of geophysical line data including magnetics, gravity, radiometrics, EM, digital terrain data, and satellite imagery.

TargetMap™ produces five (5) **standard responses** for each filter resolution, viz.

1. **BROAD response:** shows the broad or long-wavelength response associated with broad near-surface features and deeply buried anomaly-sources;
2. **SHALLOW response:** this is the BROAD response subtracted from the RAW survey data and shows the high-frequency response of near-surface features;
3. **HIRES (high resolution) response:** a pseudo-image of the survey data that shows broad textural features and the strongest linear and curvilinear features;
4. **LINEAR response:** shows linear and curvilinear features with the background response removed; and
5. **SPOT response:** shows “spot” anomalies and high-frequency textural noise by removing the broad, linear and curvilinear features.

The five standard responses are powerful mapping and interpretation aids. In addition, the specialised **OMNI (omnidirectional)** response delineates linear and curvilinear features over a selected range of strike. It is very effective for mapping weakly magnetic heavy mineral sands strand lines.

Some applications of TargetMap™ include: detection of large 3-dimensional bodies buried below surface basalt, surface maghemite, or other overburden of variable thickness; detection of long 2-dimensional structures, such as contacts, dykes, and stratigraphy; detection of individual lenses in magnetic banded-iron-formations and greenstone belts buried below magnetically noisy overburden; detection of magnetic heavy mineral strandlines buried amongst near-surface residual magnetic iron-oxide deposits; detection of curvilinear structures associated with contacts of circular bodies and curved dykes; delineation of detail and changes in textural responses associated with near-surface features, including weathering effects, (paleo-) drainage and alluvial deposits; detection of “spot” anomalies located on linear and curvilinear features and in linear stratigraphy.

TargetMap™ has been effective in detecting circular and often complex responses of a number of different types of compact mineralised bodies, including diamond pipes. It can detect dykes and structures in magnetic data from coal and petroleum basins, and has been effective in delineating features in airborne gravity data for both minerals and petroleum. It can also separate the broad surface response from radiometric and EM data to resolve detail, texture and linear features.

3 TargetMap™ processing products

The TargetMap™ standard processing package includes

1. four (4) filter resolutions to provide a range of wavelengths, usually resolutions 1, 3, 5 and 10;
2. five (5) **standard responses** for each filter resolution, a total of twenty (20) responses;
3. ASCII located data files containing the output responses for each filter resolution;
4. ER Mapper grids of the twenty (20) TargetMap™ responses and the raw survey data; and
5. a TargetMap™ data processing report.

TargetMap™ is a powerful targeting, mapping and data interpretation aid that is a basis for the geological interpretation of most types of geophysical survey data. It is highly effective for detecting and enhancing the responses of a wide variety of geological features and has been successfully applied to magnetics, gravity, radiometrics, EM, digital terrain data, and satellite imagery. TargetMap™ can be applied to most types of airborne and ground survey data and is helping geologists to use geophysical data from a wide variety of geological environments.

TargetMap™, a new standard in geophysical data processing

- sees through the masking effects of near-surface geology and noise;
- increases resolution of deeper geology;
- increases resolution of near-surface geology;
- maps linear and curvilinear features;
- resolves "spot" or "bulls-eye" anomalies in complex geology;
- improves target definition;
- reduces interpretation costs by helping geologists to interpret complex survey data;
- is applicable in all geological terrains, including areas with basalt flows and surface maghemite; and
- is suitable for airborne and ground geophysical data, eg magnetics, gravity, radiometrics and EM.

TargetMap™ is the most accurate, fastest, and cheapest way of analysing geophysical survey data.

TargetMap™ is a trade mark of Vector Research Pty Ltd.

Another innovation from the research laboratory of Vector Research.

TargetMap™ was previously known as the **Overburden Filter™**. Following suggestions from many users, the name has been changed to better reflect its full targeting and mapping capabilities.