HIGH RESOLUTION MAGNETICS IN THE PRESENCE OF INTENSE NEAR SURFACE MAGNETIC NOISE

by

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DECLARATION

I declare that no part of this thesis has been accepted or presented for the award of any degree or diploma by any University, and that to the best of my knowledge the thesis contains no material previously published or written by any other person except where due reference is given to that author by direct credit in the text or bibliography.

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ABSTRACT

The general problem of magnetic exploration in a region of near surface magnetic noise interference has been studied with particular attention being devoted to the specific example of the Elura orebody underlying a maghemitic noise source. Prime considerations were the relative merits of ground level and airbrone surveys, data sampling requirements, and filter processes by which optimum enhancement of a deep source signal could be achieved with least distortion.

The primary objectives of the research program were to define and quantify the signal and noise waveform parameters, to investigate the filtering operations that could be applied to distinguish between signal and noise waveforms, and to quantify the signal to noise ratio that could be achieved from both airborne and ground level magnetic surveys in the presence of intense near surface noise.

The characteristics of noise from the most commonly encountered near surface sources were described and defined. A similar generalization of the signal characteristics could not be made because of the dependence upon the definition of each individual exploration target. In this study a limited definition of "signal" was used. The anomaly arising from a large subsurface geological structure such as a lithological boundary, fault, or base metal deposit of economical dimension was considered as "signal". The Elura orebody was adopted as a practical model of a signal source because it was of economic but relatively small size and it was of magnetic susceptibility representative of many base metal sulphides. From this particular model a magnetic signal could be precisely defined for varying depths of burial of the source. The geological environment of the Elura orebody was described as a case example where signal and noise sources could each be related to their geological origin.

Having defined the characteristics of the signal and noise being studied, the data sampling parameters and required instrumentation could be specified. Relevant filter techniques were proposed and an assessment of the application of each to field data from the Elura study area was presented. A quantitative measure of signal, signal distortion and residual noise was obtained allowing a direct comparison to be made between the fil-

tering techniques examined and their application to data recorded from different sensor heights above the near surface noise source.

The data sampling and processing procedure demonstrated to produce the best signal to noise ratio was applied to the Elura mine grid area. The resolution and fidelity of the resulting magnetic map was shown to be approximately five times better (as measured by signal to noise ratio) than previously published magnetic survey results. When the processed data was compared with data calculated from the published structure of the Elura orebody, the source of the principle feature of the map was clearly identifyable as the Known orebody. The map however also resolved previously unrecognized additional deep source, structural information in the area surrounding the orebody. The origin of this signal has not yet been established.

The results of the case study were extended to enable specification of theoretical depths at which the Elura orebody could have been detected, and theoretical tonnages of mineralization of Elura composition which would be detectable at different depths. Exploration beneath a maghemitic palaeochannel was finally considered as a worst case example of exploration beneath a near surface noise source.