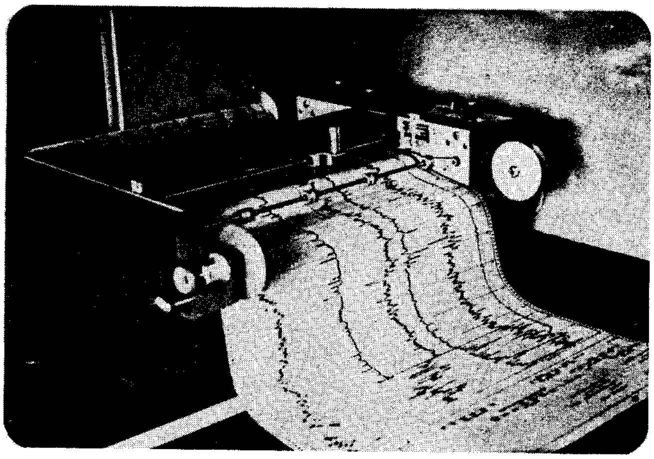

On-site plotting
Composite plots

Automatic plotting on site can then produce logs and table listings of the above derived data as well as producing "cross plots" of different sets of parameters. The larger plotting areas available with automatic plotters enables as many as 10 separate traces to be placed side by side for ready correlation. Re-plotting of zones of interest at expanded scales is possible and gains and offsets can be adjusted automatically to provide a neater presentation. Header information is also added automatically. The above plotting can be performed whilst the truck is moving to a new site, thus saving on documentation time.

The entire sequence of logging operations can be displayed as an instruction set for a virtual novice to follow and checks on the operator and the equipment instituted.

INTERACTIVE EDITING OF COMPUTER-GENERATED GRAPHICAL DATA

M.J. McLean

M.J. McLean and Associates Pty Ltd, Computer Graphics Consultants (07 – 376 1847)

Computer generated plots of geophysical data are rarely used directly as finished drawings. Instead, they are edited in conventional drawing-offices to remove problems such as spot-heights which are overwritten by contours, and data which has been incorrectly interpreted by the computer. Conventional manual editing adds significantly to the overall time required to produce drawings and also adds to the cost of such drawings.

The paper describes an interactive computer program that permits plots to be displayed on a graphic screen and edited to finished drawing standard before they are plotted, thereby eliminating the need for time consuming manual editing. The program is written in FORTRAN and runs on both mainframe and minicomputers. Editing takes place at a workstation containing a storage graphics display and keyboard, a visual display unit and a digitiser.

Editing commences by calling onto the screen the plot to be edited. A zooming facility enables the editor (draftsman) to zoom in onto any particular area of the drawing on which he wishes to work in detail. Editing commands are entered via the display keyboard while positions and items in the drawing are pointed at using the crosshair facility provided in the display. There are three main classes of editing commands, namely, insertion commands, deletion commands and manipulation commands.

The following entities may be inserted into the drawing: single lines, chains of lines, text, circles, circular arcs, ellipses, regular polygons, crosshatching covering arbitrary areas, french curves which pass exactly through given data points, standard symbols, and other drawings (plots) or parts thereof. Single lines are inserted by specifying their end points either by using the crosshair on the screen or by digitising the ends of a line on an existing drawing. Chains of lines representing, for example, coastlines, may be inserted by turning the digitiser to stream (continuous) mode and tracing the coastline on an existing map on the digitiser. This could be used to insert a coastline onto a computer plot of, say, gravity contours. Blocks of text may be inserted anywhere in the drawing at any size and orientation, and automatically justified and centred as required. Circles, circular arcs and ellipses can be specified in a number of ways, as can regular polygons with any number of sides. Crosshatching may be inserted into areas bounded by arbitrarily complex polygons, e.g. the zone between two contours. Control is provided over the slope and spacing of the crosshatch lines, and complex crosshatch patterns can be used. French (smooth) curves which pass exactly through specified sequences of data points may be automatically inserted. The curves can form closed loops or can be "open" with various specified conditions at their ends. Standard mapping and other symbols may be called up from a library and inserted anywhere in the drawing, while new symbols are easily created and inserted into the library. Whole drawings, or sections thereof, may be scaled and/or rotated and copied into the drawing on the screen, thereby permitting the preparation of composite drawings from several different plots.

Any of the entities described in the previous paragraph may be deleted simply by pointing with the crosshair at any part of them and typing the appropriate command. Pointing need not be precise since the computer will choose the entity with a line closest to the crosshair. In addition, an arbitrary area of the drawing may be erased simply by defining its (irregular) boundary using either the digitiser or the crosshair and typing the appropriate command.

A similar facility to the erase facility enables arbitrary sections of the drawing to be relocated on the drawing. This permits, for example, elements of drawings to be slid apart when it is required to insert information between them.

Plots may consist of up to 16 logical layers which are analogous to transparent overlays. Different types of information may be stored on different layers and may be selectively displayed, edited and/or plotted. For example, a contour plan might contain its major contours (say, every fifth) in one layer, its minor contours in another, and its spot-heights in a third. This would render it possible to plot all the information together, or to plot only the contour information, or to plot only the contour information, or to plot only the spot-heights. Further, it would be possible to extract only the major contours, scale them and plot them in a small scale map with reduced contour interval.

In addition to providing purely graphical features, the interactive editing program provides limited computational features. For example, it permits distances to be scaled-off the drawing and accumulated. When used in conjunction with stream digitising, the facility permits lengths of roads etc. to be scaled directly from maps. Similarly, the program provides a mechanism for calculating arbitrary areas which, when used with the digitiser, provides a convenient planimetric facility.

The interactive editing program is easily incorporated into existing plotter-based graphics systems. Minor modifications to existing programs enable the creation of plot files that are compatible with the editing program. However, if the full benefit of features such as layers is to be achieved, more extensive modifications of existing programs may be necessary.

In summary, the paper describes an interactive graphical editing program that can run on most computers and can eliminate the time-consuming process of manually editing computer generated plots.

LOOKING DEEPER – CHANGING TACTICS FOR URANIUM EXPLORATION

Bruce L. Dickson

CSIRO Division of Mineral Physics
(02 - 888166)

Uranium exploration is the US, Canada and Ausralia is undergoing a fundamental change. Shallow deposits with surface expression detectable by airborne or ground radiometrics are becoming more difficult to find. Yet it is in these areas where exploration has been most successful in the past few years becuase of subcropping deposits which still retain enormous potential for future discoveries. Geophysical methods such as aeromagnetio EM and magnetometer surveys, coupled with geological interpretations of known deposits, have proved very successful, for example in the Athabasca Basin in Northern Saaskatchewan, where many potential mineralized zones have been located at depths of 150 m or more. However drilling all the possible anomalies has proved an expensive strategy with a low success rate, although at least one deposit (West Bear) has been located in this way (Armstrong and Brewster, 1979).

There is now a need for techniques that can rapidly, and with confidence, pinpoint uraniferous anomalies from the surface. The methods most likely to fulfil this need are those based on the mobility of uranium and its decay products. A summary of the decay series of uranium and the potential of the different isotopes for use in exploration is given in Table 1. Uranium, radium and radon are the most mobile elements, either through their solubility and transport in waters of different compositions or by gaseous diffusion. Helium-4 is produced as a result of alpha decays in the decay of uranium and can also be used as a uranium indicator.

Radon detection is probably the best known method in use for locating buried uranium. It has had a chequered career but the problems associated with direct determinations of radon in soil gas, such as diurnal variations and effects due to weather changes, have been overcome by the use of methods involving long-time integration of the radon measurements. Two systems commercially available use alpha registration films (Gingrich and Fisher, 1976) or silicon surface-barrier detectors (Warren, 1977) to detect the alpha emission of radon decay. Both detectors are placed in the ground above a suspected deposit for periods up to 30 days, but whereas the silicon detector results can be obtained immediately after the waiting period, the films must be processed at the suppliers' laboratory before any results are available. However, if a large area were to be surveyed, the cost of the individual silicon detectors would prohibitive even though they could be reused in later surveys.

Another approach to radon detection is to use ^{210}Pb or ^{206}Pb measurements of near-surface samples as a natural integrator of radon flux. In this case the field cost reduces to that of sample collection. Such methods are at the research and development stage. However there are indications that measurements of $^{206}Pb/^{207}Pb$ or ^{204}Pb ratios could become as straightforward as atomic absorption determinations for trace-elements. At present such ratios are determined by mass-spectrometric measurements. The ^{210}Pb method, which gives a 100 year integration of radon flux, requires chemical extraction and alpha-spectrometry which may make it too expensive apply to field surveys using current methods.

Another technique being investigated as a means of locating deeply-buried uranium deposits involves measurements of helium-4; The decay of one ^{238}U produces one ^{222}Rn atom but eight helium atoms, an amount of 0.115 cm^3 He per tonne ^{238}U per year. Being light and inert, helium has a great tendency to escape into fissures thus allowing migration away from the site of its formation. Field mass spectrometers have been developed to measure helium in soil gas, and also the ration$^4He/^{36}Ar$(Reimer, 1977) from which corrections can be made for the effect of variations in atmospheric pressure and temperature on the background helium level. Published results of helium surveys parallel the experience obtained with radon measurements. Some buried deposits show He haloes, some do not. However the helium and radon measurements should be considered complementary. ^{222}Rn with a mean half-life of 5.5. days, must move rapidly to give detectable concentrations, whereas helium must accumulate to be recognisable above the general background level of 5 ppm. Hence helium cannot be expected to be as useful as ^{222}Rn in areas where rapid gas movement is possible although where relatively impervious geological structures overlie the suspected deposit, helium contents of soil gas might be the preferred method.

The major problem concerning the application of both radon and helium determinations to the location of uranium deposits is the lack of knowledge on how these, and other uranium decay products, migrate below the surface. The movement of radon is a matter of some controversy; one