Conference Report

Geological applications of GIS

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Geological Information Systems (GIS) was the theme of the AGM of the Geoscience Information Group held at the NERC Unit for Thematic Information Systems, Reading University on 17 September 1991. The meeting was convened by G. Wadge to discuss what geological problems can be addressed by current GIS and what new technical capabilities are required to solve other problems. Eight papers were presented to an audience of 61 and five GISs were demonstrated over an extended lunch break.

GIS has the potential for making published map revision easier and cheaper in the way that word processing has done away with repeat typing of draft manuscripts. J. L. Laxton (BGS Edinburgh) illustrated this potential by describing how a series of ten thematic geological maps from the Wrexham area, derived from solid and drift geological maps, borehole and quarry information, were created. ARC/INFO was used for input, editing and overlay operations to produce vector maps. These were then transferred to a LEGIS (now HORIZON) system for combination with a raster base-map prior to plotting and production of masters for printing. Despite a number of technical problems it was argued that the data checking involved in this process produced a better quality product than traditional methods.

In the first of three papers involving engineering geology applications, P. Nathanall (Wimpey) & M. Rosenbaum (Imperial College) gave an overview of the requirements of a GIS for this discipline. Data, particularly data structure, data storage and models of ground conditions were seen as key issues. Two examples of separate raster- and vector-based studies were presented; the first from the Humber estuary and the second from Gibraltar. A generally relevant conclusion from their work was that currently data entry, transfer between the second from Gibraltar. A generally relevant conclusion from their work was that currently data entry, transfer between GIS and validation of quality were difficult and lengthy processes. Ground instability problems in Cyprus were the examples used by G. Wadge, E. Pearson & A. P. Wislocki (Reading University) to illustrate the use of GIS for hazard assessment. They argued that there were two basic approaches that GIS allowed: an empirical one that used past hazard events to provide statistical weightings of relevant variables for global mapping, and a deterministic one that assumed a model of the physical processes of hazard. ARC/INFO was shown to be well-suited to some of these tasks but the need to go outside the GIS to other software to perform statistical and modelling tasks was emphasized. A. Brass (Reading University) presented a detailed case example of the deterministic approach in his study of the use of SPANS for mapping the potential for shallow, translational landslides in Dominica, West Indies. The GIS calculated the factor of safety equation for each raster, based on values of slope and geotechnical properties of soils. Trigger mechanisms of increased pore pressure due to rainfall and earthquake accelerations were modelled, and the use of probabilistic weightings for their recurrence intervals and also for the spatial variability of soils properties was shown to be feasible on a PC-based GIS.

The afternoon session began with three papers concerned with mineral exploration. C. J. Moon & C. L. Wang (Leicester University) discussed the evaluation of an alluvial gold prospect in south Devon. A variety of deposit models were used to generate probabilities of occurrence with Bayesian techniques from data on geology, topography, mineral occurrence and geophysics using the IDRISI system. The point was well-made that it is appropriate to treat stream sediment data as polygon data in a GIS because this best represents the catchment from which the sample was derived. BRGM has developed its own system, SynerGIS, and C. Braux & D. Bonnefoy (BRGM, Orleans) described its use in developing separate models of gold prospectivity in Brittany and Vietnam. They showed how the quality of the GIS results and their validation depended on the resolution and location of the data and the accuracy of the non-spatial attribute data and how errors can accumulate from both data and GIS processing itself. The Geological Survey of Canada has been one of the main practitioners of GIS applied to geology and G. Bonham-Carter (GSC, Ottawa) gave a valuable review of their latest experiences of both data-driven and knowledge-driven modelling of mineralization potential. He showed how knowledge-driven modelling of prospectivity for copper in British Columbia was performed. The spatial data held in the raster GIS SPANS was used to derive Bayesian probabilities of mineralization by recourse to models of mineralization held outside of the GIS in the expert system PROSPECTOR.

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C. J. Evans, J. Rees & K. Ambrose (BGS, Keyworth) gave a talk that looked aside from traditional GIS to future developments in 3D modelling of geological data. This was being done in the context of an evaluation exercise of a variety of packages using a test data set based on the Grantham sheet. Products from IVM, Stratamodelling and Vulcan were described. One lesson from this work is the great difficulty in providing meaningful extrapolation and interpolation away from dense concentrations of data such as along boreholes.

It was clear from the attendance at this meeting that GIS is of increasing interest to geologists and that some of the issues relevant to making it a practical tool are being considered. Well-conducted and widely published applications will accelerate this trend. Perhaps surprisingly, the national Geological Surveys, rather than the Higher Education institutes and industry, seem to be making much of the running.