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Geological mapping in the USA

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In Lexington, Kentucky, on June 11, 2014, members of the Association of American State Geologists (AASG) unanimously passed a resolution that endorsed planning by U.S. Geological Survey (USGS), and that cited pressing issues related to energy, minerals, water, hazards, climate change, environment, waste, and engineering, as well as research priorities, to call for accelerated progress on a national, regularly-updated, well-coordinated, multi-resolution, seamless, 3D, material-properties-based geological mapping database. Researchers and land use managers increasingly rely on and therefore need to invest in geologic mapping that will return benefits, including lives saved, resources discovered, costs avoided, increased efficiency, and improved understanding of earth composition, structure, and history. Provision of standardized and accessible geologic mapping is facilitated by the National Geologic Map Database (NGMDB), which is managed by USGS in cooperation with AASG, with proven arrangements for administration, data, stratigraphy, and standards. Mapping at state and national scales in the US is complete, although in need of updating. At scales needed for planning, coverage is only about 50%, and these maps typically are unreconciled relative to each other. Subsurface mapping needed for groundwater management and sedimentary basin assessments is even less complete. The superb nature of completed mapping, and compelling user needs, thus call for acceleration and enhancement of this activity.

Users now expect maps to be zoomable, and to be queryable over broad areas. In addition, the demands of modelling increasingly call for a focus on material properties such as lithology and hydraulic conductivity. The public sector role commences with county and quadrangle-scale 2D mapping, the most important scale for land use planning. Each state geological survey can determine the most appropriate scale for their focused investigations, and also the intermediate scale that will be achievable state-wide. State-wide seamless compilations of quadrangle- or county-scale mapping are being built on an incremental basis, in part to make GIS resources manageable. Links to source information, at least as scanned versions of both maps and reports, provide documentation for advanced users, as well as credit and responsibility for the source map authors. Accompanying 3D geological mapping that depicts extent, thickness, properties, heterogeneity, and uncertainty of strata is based on data compilation and acquisition, facies modelling, and basin analysis. Model construction, including use of geostatistics, varies depending on resolution, complexity, as well as data format and adequacy. A basement map also is needed, with geometry of selected structures, along with discretized physical properties. The urgency of user needs calls for mapping of this nature to be completed nationally at appropriate levels of resolution within a decade or two, and updated periodically, in some areas every two decades or so, owing to increasing access, new topographic mapping, accumulation of data, as well as progress in science and technology.

There thus is an urgent need for geological mapping to be progressively more: focused on user needs while accommodating unanticipated applications; conducted as part of a well-planned program based on ongoing assessment of required databases; focused on the most detailed mapping where needed; committed to jurisdiction-wide completion at an appropriate level of resolution; reconciled from

onshore to offshore with topographic and bathymetric data; coordinated with soil mapping; based on compilation of drillhole and other data, along with strategic drilling and newly acquired geochronology, geochemistry, and geophysics; based on sound stratigraphic naming; categorized using accepted terminology; committed to regular updating; assembled as state-wide seamless compilations; 3D, in which the extent, thickness, and properties of layers, and geometry of selected basement structures are distinguished; material properties-based; coordinated with 3D versions of state, continental, and global-scale maps; accessible through open-source software; and linked to databases as well as searchable publications. Surveys need to aggressively transition to this approach, to better fulfil their essential role in society.