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Geological maps of the future

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Geology has always been associated with maps, and geological maps are still the principal tools to illustrate the distribution of geological features in space, on Earth and on other planets and moons. Until the onset of digital mapping, the best option to produce a map was a paper map. The amount of information that can be shown is limited by the size of the map, its scale, resolution and the number of colours that can be used. Despite many limitations of paper maps, they have the great advantage that information stored on them is stable and cannot be changed, providing a permanent record of the state of knowledge/interpretation at a given point in time, while this information can be stored for centuries.

With the advance of fast computers and the internet, the presentations of maps has changed in a spectacular way. Digital maps can be simple digital images of a paper map, but a “real” digital map deviates in nearly all points from a traditional paper map. Such maps can be multiscale, showing both small scale and large scale features in the same map - some areas with closely packed data can show small details while others, where data are sparse or homogeneous, do not show this; they can have internal legends, linked to map objects; and they can show 3D aspects both of the terrain and the deeper geology, without the need for separate sections and block diagrams. Digital maps have the added advantage that different layers such as topography, infrastructure, deformation structures, metamorphism, lithology, and metadata can be selected, depending on the interest of the viewer. All objects on such maps can be easily searched. Digital maps have the disadvantage that they are vulnerable and difficult to store on a permanent basis.

Digital and paper maps share one common property: they are man-made interpretations of reality based on geological data. Such interpretations are necessary to reduce the amount of data to a manageable density, and to filter and enhance original data in terms of relevance and quality. As such, maps bear the strong signature of a geologists interpretation, and all maps can be modified and hopefully refined or improved by changing the interpretation and by addition of new data. Maps have the advantage that the geology is easy to interpret and understand, but the disadvantage that the interpretation may be coloured by the geologists experience, or simply wrong. In order to make a personal assessment of a geological situation, it is in many cases necessary to revisit the original area, and to remap it. Remapping is a reality at many geological surveys and companies, and to a certain extent will always be necessary. However, digital maps have the option to include important parts of the original geological dataset in such a way, that remapping is less necessary. Although chemical and physical data can be shown fixed to a location, the most important data source for structural geology, sedimentology and a number of other disciplines are the geometries visible on outcrop surfaces. During

the mapping process, observations in outcrop are filtered for those data that are useful for the study at hand, and combined with other data to provided local interpretations on which a map is later based. Such basic data, in the form of 3D outcrop casts, can now be included in digital maps to provide a digital database storage comparable to the lab-book of laboratory experiments. Future developments could link basic outcrop data with digital maps, allowing virtual remapping without the need to collect all data anew in the field. This could be cost-reducing, and provide a solution for areas that are either too dangerous to visit, or where outcrops have been destroyed.