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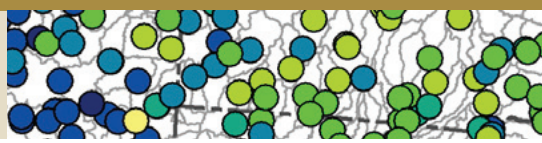
Preliminary Soil pH map of Australia

New dataset will support resource evaluation and environmental monitoring



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Data gathered in the field during the sample collection phase of the National Geochemical Survey of Australia (NGSA) has been used to compile the *Preliminary Soil pH map of Australia*. The map, which was completed in late 2009, offers a first-order estimate of where acid or alkaline soil conditions are likely to be expected. It provides fundamental datasets that can be used for mineral exploration and resource potential evaluation, environmental monitoring, landuse policy development, and geomedical studies into the health of humans, animals and plants.

Background

Since their inception in the 1960s, regional geochemical surveys have proven to be a reliable tool for mineral exploration, particularly as a complement to other regional, national or continental-scale geological and geophysical datasets. However, until now there has been no geochemical coverage for the whole of Australia.

The National Geochemical Survey of Australia (NGSA) project was initiated in late 2006 as part of Geoscience Australia's Onshore Energy Security Program (Johnson 2006). The Program provides pre-competitive data and knowledge to support exploration for energy resources in Australia. As a spin-off, the NGSA will also establish a baseline geochemical database and atlas, which will find applications in various disciplines. The NGSA is carried out in collaboration with each of the state and Northern Territory geoscience agencies.

Sampling strategy

Catchment outlet sediments, which are similar to floodplain sediments in most cases, were the target sampling material for the NGSA. This sampling medium has been widely used in overseas geochemical surveys because it is representative of the average regolith composition in a catchment (Ottesen et al 1989). Catchments are sampled as close as possible to their lowest point (usually their outlet). Small coastal catchments and small islands were not included in the survey.

For the NGSA, catchment outlet sediments were sampled at two depths. Firstly a Top Outlet Sediment (TOS) sample is taken between zero and 10 centimetres below the surface or root zone if applicable. Then a Bottom Outlet Sediment (BOS) sample, representing an interval of about 20 centimetres is taken from a depth between around 60 and 80 centimetres (on average). Both types of samples are composites homogenised from a shallow soil pit (TOS) or a minimum of three hand-augered holes (BOS). Samples were taken from a total of 1192 catchments covering about six million square kilometres or over 80 per cent of the area of continental

Figure 1. Field sampling at the point of collection: Inoculo™ field pH kit (inset) and measurement of the pH of two soil samples.

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Australia across all states and territories. The average sampling density for the area sampled is approximately one sample every 5500 square kilometres. Sample collection and preparation were carried out in accordance with a Field Manual (Lech et al 2007) and a Sample Preparation Manual (Caritat et al 2009) compiled for the survey.

Determining the soil pH

The field pH, which forms the basis of the *Preliminary Soil pH map of Australia*, was determined in the field by the saturated paste method using Inoculo™ field pH kits developed by CSIRO (figure 1). The field pH method entails:

- saturating a small amount of soil (about one cubic centimetre) with a universal indicator
- mixing soil and indicator to form a paste
- lightly dusting the saturated paste with white barium sulfate powder
- waiting one minute for the indicator to react with the soil
- matching the colour of the powder to a chart with half pH unit increments.

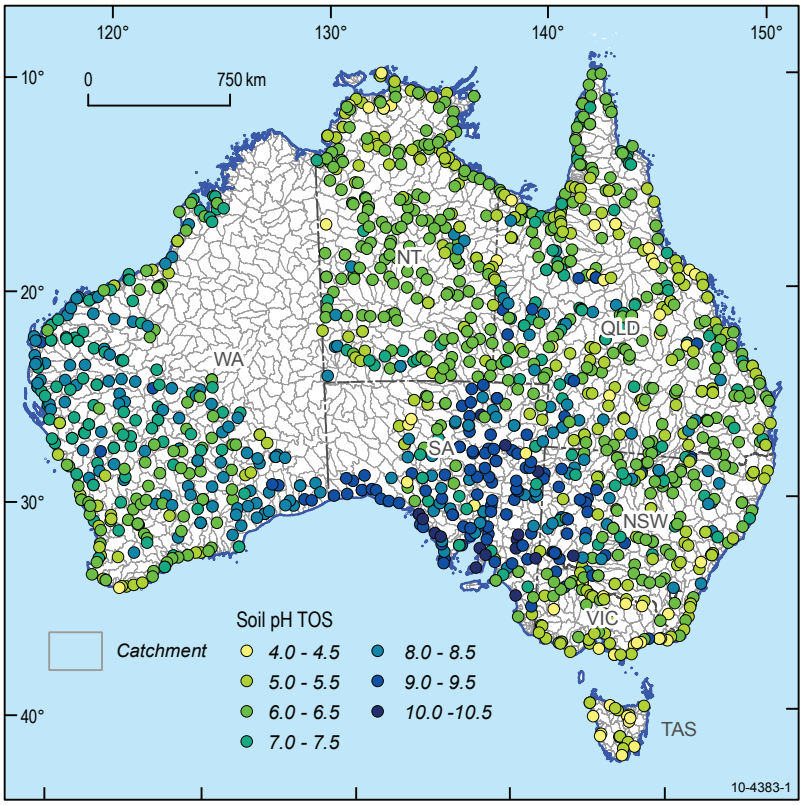

Figure 2. Distribution of soil pH values determined in Top Outlet Sediments (TOS) by the National Geochemical Survey of Australia. The symbols are coloured according to the pH recorded at the sampling site.

To some extent this empirical method depends on the user's ability to match colours and on lighting conditions; it also only has a resolution of one half of a pH unit and hence is a relatively 'coarse' measurement. Therefore, results should be considered a 'first pass' only. Preliminary comparisons with (a) pH values determined in the lab using solutions with a ratio of one unit soil to five units water, and (b) with pH estimates derived from visible near-infrared spectroscopy, however, suggest general correlation and overall robustness of the field pH data. The data is based on one site per catchment and cannot, therefore, inform on intra-catchment pH heterogeneity.

Results

The NGSA field pH data has been compiled into a data file and maps, which are available through the Geoscience Australia website. Figure 2 shows the raw point data for the TOS soil pH at the point of collection. The downloadable maps also include a catchment-based representation (mosaic map) of this data, as well as presenting the BOS sample data in both formats.

The *Preliminary Soil pH map of Australia* will be useful to many stakeholders, including those involved in mineral exploration, agriculture, natural resource management, and infrastructure protection. Metal mobility in the near-surface environment is strongly influenced by pH

conditions. Soil acidification (Brennan et al 2004) and alkalinisation (Wong et al 2008) are increasingly important problems for agriculture and soil protection in Australia as they impact on soil productivity, soil toxicity, and element deficiency. The map will also potentially be useful in studies of surface water, soil water, and groundwater quality assessment and prediction. There is evidence of a correlation between areas with high soil pH values found during the NGSA project and areas previously identified as containing extensive soil carbonates (figure 3: Chen et al 2002), particularly with the BOS samples.

More information on the project is available through the Geoscience Australia website (see below) or in Caritat et al (2008).

For more information

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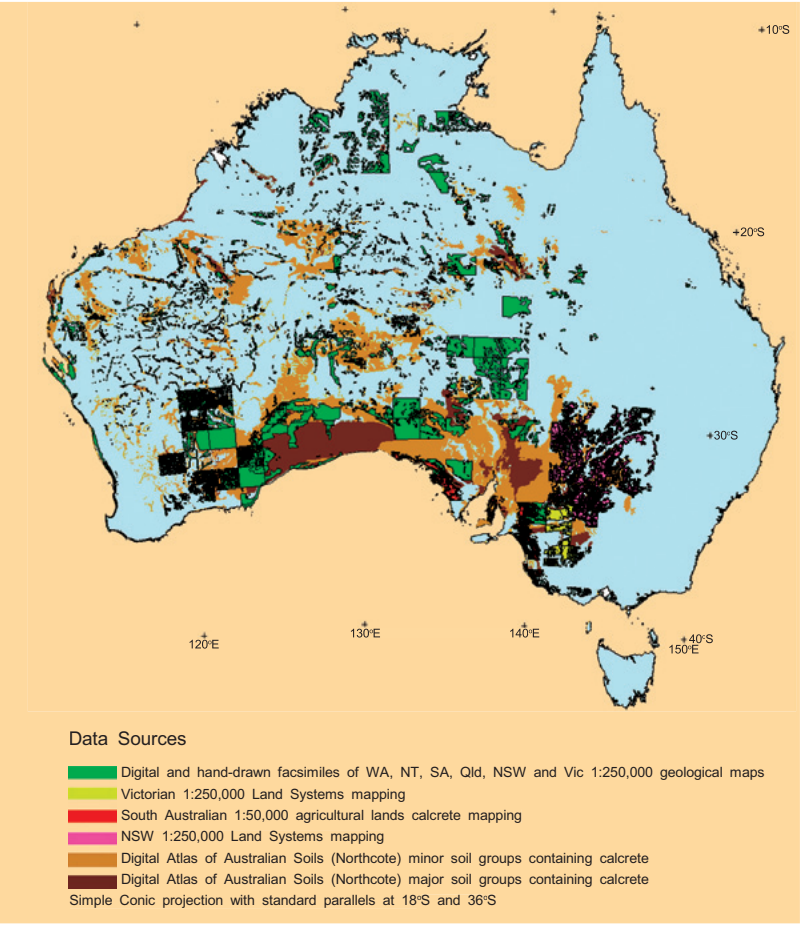

Figure 3. Distribution of regolith carbonate in Australia, shown mostly as brown shades (Chen et al 2002).

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Related websites/articles

Preliminary Soil pH map of Australia may be accessed through the National Geochemical Survey of Australia
www.ga.gov.au/ngsa