18th Professor GW Leeper Memorial Lecture

The ASSSI Victorian Branch and the University of Melbourne's School of Land and Environment jointly hosted the 18th Professor GW Leeper Memorial Lecture on Friday the 27th of November 2009. The lecture was attended by approximately 100 people, about half of these being ASSSI members.

Mr Jim Rowan, an honorary life member of ASSSI, was the introductory speaker who gave an account of Professor Geoffrey Leeper. Jim recognised that Professor Leeper possessed a wealth of soil science knowledge and was a foundation member of ASSSI.

Doctor Robert Edis, a lecturer of plant and soil science at the School of Land and Environment at Melbourne University, then introduced Doctor Rob Fitzpatrick as the guest speaker for the 18th Annual Leeper Memorial Lecture. Rob is a Chief Research Scientist at CSIRO Land and Water and Director of CSIRO's Centre for Australian Forensic Soil Science.

Rob Fitzpatrick's principal research interests are in pedology, mineralogy, biochemistry and spatial analysis of soil-landscape processes. The focus of Rob's lecture was to provide an overview of current research activities, particularly on Acid Sulfate Soils, and the role of the Centre for Australian Forensic Soil Science.

Pedotechnology, which describes the variety of soils and their distribution, can be used to understand, predict and solve problems. Furthermore, pedotechnology is multi-scale and thus can be used to relate information at the atom scale to the landscape scale. This information can then be used by a variety of people, such as police and lawyers, and be used in situations such as court cases (e.g.murder).

Pedotechnological information was commonly used in forensic cases up until the 1990's whereby it became too specialised and expensive. Counter terrorism has since changed the paradigm for forensic science. The Centre for Australian Forensic Soil Science has now developed a systematic methodology for analysing soil samples in the modern era. It is estimated that the Centre for Australian Forensic Soil Science has saved the judicial system around five million dollars.

Analysis of soil samples by the Centre for Australian Forensic Soil Science was key to the conviction of a murderer as police had no DNA and no leads except for a soil sample that was found on a shovel in the assailant's car. The Centre analysed the soil sample and identified that the soil originated in a quarry enabling the police to locate the buried victims. More information about the Centre can be found at www.clw.csiro.au/cafss.

Pedotechnology, or specifically the knowledge relating to soil formation processes, can also be used to help predict potential hazards to water quality, land degradation, human and animal health. For example, modelling has been used by Rob and his team to predict how subaqueous acid sulfate soils will behave when they become exposed to air via drought conditions or human activities.

An acid sulfate soil contains detectable sulfide minerals, principally pyrite or monosulfides. Acid sulfate soils become a hazard when they become oxidised because they produce sulfuric acid resulting in acidification of the soil and the acidification, deoxidation and mineral release in water in contact with the soil. The soils may also crack, produce a strong odour which in dry conditions can be carried by the wind.

A major concern, and an area where Rob has been focusing his research, is the Lower Murray River area in South Australia. Lake Alexandrina's water level reduced from 1.0 metre to 0.3 metres from 1974 to 2006. As a result the acid sulfate soils have gone from being in the benign state whilst under water (sulfidic material, pH 8.4) to one of the nastiest soils in the world when they dry out (sulfuric material, pH 0.5 – 3.5). Furthermore, when the water begins to cover the soils once more the pH is so low that the aluminium and iron precipitates (> pH 3.5).

Lake Albert was covered in water during a visit by Rob in winter of 2007 but by the summer of 2008/2009 the water receded and the lake dried out. Another visit in Winter/Spring 2009 saw that the water levels had increased and the Lake was covered again. Due to the low water levels and the presence of the acid sulfate soils, the pH of the water was 2.3 – 2.8. Drought and man-made barrages have both contributed to the receding water levels in both Lake Albert and Lake Alexandrina.

Research from both Lake Alexandrina and Lake Albert has been used to develop a model that characterises acid sulfate soils during the cycles of wetting and drying and details the associated hazards. Using this model, the team have been able to advise the Government on how to manage natural resources such as the Lakes. As a result, the Government pumped water from Lake Alexandrina to Lake Albert to reduce the area affected by acid sulfate soils.

The model has also been used to manage Jury Swamp which has a high value for agriculture, particularly dairying. The models were used to predict what would happen if they re-wetted the swamp using a weir or other regulator. Another issue for this swamp is that fire has caused it to become hard-setting (resembling ceramic tiles).

Rob's future plans are to continue his work in countries such as Iraq and Bangladesh, determine the effects of shrink–swell soils on optic-fibre cables, and investigate issues related to soil in sport fields such as the MCG (Melbourne Cricket Ground). Further information about Rob's activities can be found on the CSIRO website and for further information regarding acid sulfate soils refer to the Victorian Coastal Acid Sulfate Soils Strategy (available on the DSE website).

After the lecture the attendees gathered for nibbles and beverages before gathering at University House for Leeper Lecture dinner.

Field trip

The 18th Professor GW Leeper Memorial Lecture included a field trip through part of the Corangamite catchment on Saturday the 28th of November. The field trip involved a bus tour aimed to educate the 30 participants about acid sulfate soils and the potential hazard to natural and man-made assets. Doug Crawford and Doctor Rob

Fitzpatrick were our hosts for the day. Doug leads the DPI research that identifies landscapes that have the potential to contain coastal acid sulfate soils in Victoria.

At the 1st site at Breamlea, Doug and Rob detailed how to identify acid sulfate soils and how to determine the scale of the potential hazards associated with these. A particular concern at this site is the major road that passes through, and increasing pressure from tourism and housing.

This site sits behind a coastal barrier of modern dunes that protects the site from the sea. However, as demonstrated by the shells in the B horizon of the soil (15 – 160 cm), the site was once estuarine. This feature was discussed in relation to how this soil profile formed within its geomorphological setting and how it was classified as a Hemic, Sulfidic, Supratidal Hydrosol.

The 2nd site was in a wetland that was modified during the Ash Wednesday fires (canals were dug to isolate burning peat) and is now a popular recreational park. The impact of the presence of actual acid sulfate soils was demonstrated by us measuring a pH of < 3 in water that had run off the soil excavated from a canal, and seeing the iron stained stagnant waters in parts of the wetlands. The estuary has a history of poor water quality and there have been reports of fish kills, vegetation loss and high numbers of mosquitoes breeding in the stagnant and acidic waterways. Adam Pope, Deakin University, who recently completed his PhD, came to discuss his findings from his research on the impacts of water quality on sea grass in this and nine other estuaries of the Cape Otway coast.

On route to the 2nd site we travelled through the catchment of this wetland and estuary where Adam Pope described salient features affecting water quality in the wetland. There is an open cut mine and a power station that pumps treated waste water into the river that feeds the wetland. Further up the catchment the tributaries normally have waters of about pH 4 but under normal flow conditions the water in the estuary is not that acidic. However, in high flow conditions the water reaches the wetland at Site 2 at pH 4. Thus the tour gained an appreciation of how complex coastal lowland environments can be.

The 3rd site, at Merrigig Creek, to tour examined an example of an inland acid sulfate soil. The acid sulfate soils at this site are subaqueous (covered by water) and therefore do not pose a risk at this time. The bridge carrying Blackgate Road, across the site is showing symptoms of acid corrosion, posing an infrastructure cost. The water may also provide a threat to other areas within the catchment, and waterways and/or dams, if the acidic water reaches these sensitive areas. There are also areas of primary and secondary salinity surrounding this site.

The 4th site, at Point Henry, contains man-made wetlands behind the beach and has an aluminium smelter located close by. At this site, the tour was able to learn about ‘mono-sulfidic black ooze’ an FeS containing sediment that was dug from these wetlands.