Rialtas na hÉireann
Government of Ireland

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

2017 IRC-GSI Enterprise Partnership Scheme Projects funded

1. Karst-related subsidence in Ireland: A geological and satellite-based detection scheme for infrastructure planning and monitoring

Simone Fiashi, UCD

Abstract: The term 'karst' describes a distinctive landscape developed from dissolution of underlying rocks, such as limestone, by water. Karst covers around 20% of the Earth's surface, and approximately 40% of Ireland's bedrock is limestone. Common to karst terrains are underground fissures and cavities dissolved out of the bedrock. Collapse of overlying rock and/or soil into these features commonly results in surface depressions ('sinkholes'). These depressions range in diameter from 1-500 m, and may form over tens of years or tens of minutes. Karst terrains therefore present special hazards to the construction and long-term stability of roads, railways, bridges, buildings and underground facilities. To evaluate and mitigate the risks to infrastructure, it is necessary to constrain the geometric attributes, spatial distribution, and controlling factors of these karst features. The proposed research is an innovative combination of remote sensing, geological analysis and numerical modelling to investigate geological controls on cavities and subsidence in the limestone karst regions of Ireland. The project focusses on an area that spans the exposed upland karst of the Clare Burren and the 'mantled' (i.e. buried) lowland karst of East Galway. This area also contains a major new infrastructure project, the M17/18 motorway. The attributes and distribution of karst subsidence features will be mapped by generating new high resolution digital elevation models of the area from novel optical satellite data.

Geological controls will be constrained by the first integration of existing 3D cave maps, structural geological data and the new morphological data, and tested through cutting edge numerical modelling. Furthermore, specialised Differential Synthetic Aperture Radar Interferometry (DInSAR) techniques will be employed to detect any ground instability affecting infrastructure. The research outcomes should inform pre-construction planning of infrastructure in Irish karst regions and test a new approach in Ireland for post-construction detection and monitoring of instability.

2015 IRC-GSI Enterprise Partnership Scheme Projects funded

1. Combined chemical and microbiological approaches to map and assess microbial breakdown of organic pollutants in the water and sediments of Dublin Bay.

Aisling Cunningham, DCU

Abstract: Petrochemical and sewage wastes are found in a variety of environments. Increasingly the marine environment is a significant site of contamination. In this project we will; 1. Map pollutant concentrations in Dublin Bay and 2. Develop viable methodologies that can be applied to analyse polluted areas to allow remediation companies and stakeholders to assess the extent of pollution in specific contamination scenarios.

The bioremediation and treatment of many coastal polluted sites is complicated by the need to understand the related microbial biodegradation under specific environmental constraints. If bioremediation is to be effective, it is essential to develop approaches that allow us to study the diversity of microorganisms that are degrading pollutants in-situ – we need to learn the relationship between bacteria present and degradation processes. In this project we will assess the nature of microorganisms that degrade pollutants of interest in Dublin Bay. It will contribute to a larger project where the nature of marine pollutant biodegradation using a combination of geochemical and meta-genomic approaches is explored. The proposed research group have previously developed viable, multidisciplinary and novel methodologies where information is gained on the nature of microorganisms that are degrading pollutants in-situ. These data can be used to assess rates at which existing pollutants may be potentially degraded under different metabolic conditions (e.g. aerobic vs. anaerobic).

Importantly, if we can identify specific genes and biomarkers associated with microbial degradation, we can investigate whether their relative distribution can be used as a diagnostic quantity that is proportionate to the amount and degradation state of the pollution. This approach could potentially be used by the hydrocarbon industry to distinguish thermogenic vs. biogenic hydrocarbons. Different hydrocarbon mixtures should be linked to different degrading microbial populations. Assays that target cold-seeps could then be used to provide evidence of the source of subsurface hydrocarbons.

2. Mapping Malin: A geological interpretation of the Malin Shelf

Kieran Craven, Maynooth University

Abstract: In recent years (2000-present), the Irish National Seabed Survey (INSS) and Integrated Mapping for the Sustainable Development of Ireland's Marine Resources (INFOMAR) (Geological Survey of Ireland [GSI] and Marine Institute collaborations) have provided unprecedented quantities of high quality data on Ireland's offshore territories. Bathymetric, backscatter and shallow seismic data collection continues in near shore regions as multiple industries seek to develop the Shelf regions (e.g. fisheries, marine renewable energy, and hydrocarbon exploration). This project aims to use available, high-resolution geophysical data and associated seabed sediment samples to map approximately 25,000km2 of the shallow geology of the Malin Shelf (54°-56° North and 7°-10° West, <500m water depth) off the north and north western coasts of Ireland. The determination of sediment type and quantity (i.e. extent and thickness) will be a crucial component of any future evaluation of the region's capacity to host industrial activity. Seabed geology forms the architecture upon which biological habitats build. This study

will map this physical framework and provide new knowledge in a region with significant development potential to ensure best practice, including the highest levels of environmental protection, in any development. Hence this project fits two of the priorities of the European research framework Horizon 2020 through excellent science and providing opportunities for competitive industries.
This study provides a logical continuation for the proposed researcher, including the acquisition of new skills. Previous experience with onshore and coastal Quaternary sediments in Ireland will be applied to the near shore continental shelf using industry standard methodologies and software. The proposed institutions will aid the project greatly. The GSI has been central in developing Ireland as a world-leader in seabed mapping including methodologies, human capacity, know-how and physical infrastructure. Maynooth University contains state-of-the-art laboratory facilities for investigating marine sediments, alongside hosting a research group with a proven track-record of sedimentary geology.

3. Radon monitoring and hazard prediction in Ireland

Javier Elio, Trinity College Dublin

Abstract: Radon is a naturally occurring radioactive gas which forms as a decay product from uranium. Radon does not have any colour, taste or smell and can only be measured with specialist detectors. It is the largest source of natural ionizing radiation affecting the global population.
When radon is inhaled, its short-lived decay products can interact with lung tissue leading to DNA damage and development of lung cancer. Ireland has the highest levels of radon in Europe and eighth highest in the world. Every year some two hundred and fifty deaths in Ireland are directly related to radon exposure. Radon monitoring conducted by the Radiological Protection Institute of Ireland (RPII; now the Environmental Protection Agency Office of Radiological Protection; EPA ORP) and the Northern Ireland Environment Agency (NIEA) are predominantly based on indoor radon measurements. These surveys have been instrumental in raising public awareness of radon, but resultant hazard maps are hampered by an uneven distribution of tested dwellings, uncertainties in exact locations and extensive areas with little or no testing. As such, these kinds of maps are of limited use in a predictive capacity.
This project will make use of recently available high-resolution airborne gamma-ray spectrometry (radiometric) maps (specifically equivalent uranium and thorium) and soil geochemistry data from much of Ireland. These will be used with other geological information (e.g. rock-type) to construct a high-resolution radon hazard map of Ireland. Selected test sites will be further studied using soil radon measurement in order to better understand factors affecting production, transport and accumulation of radon in the natural environment. Such mapping of radon-prone areas will ultimately help to inform when prevention and remediation measures are necessary. A reduction in radon exposure will result in a decreased likelihood of developing lung cancer and a corresponding lowering of the national health burden.

4. Environmental mapping of Dublin Bay: new diagnostic tools to assess organic pollution and its fate.

Alan Lee, DCU

Abstract: The aim of this project is to map and assess the source, concentration and potential impact of incomplete combustion and sewage discharge on sedimentary microbial populations in Dublin Bay. The project will enable companies involved in marine sediment and water remediation, petrochemical exploration, and related legal/insurance activities to access novel approaches that will enable comprehensive assessments of marine contamination and hydrocarbon distribution. This work will contribute to a larger project where the nature of pollutant biodegradation in marine environments using a combination of geochemical and meta-genomic approaches is explored. The proposed research group have previously developed a viable, multidisciplinary and novel methodology that can be applied to the analysis of polluted sediments to inform of the extent of pollution in specific contamination scenarios. Information is gained on the nature of microorganisms that degrade pollutants of interest in-situ and these data can also allow assessment of the rates at which existing pollutants are degraded under different metabolic conditions (e.g. aerobic vs. anaerobic).

Most significantly, if we can identify specific genes and biomarkers associated with microbial degradation of pollutants, we can investigate whether the relative distribution of these markers can be used as a diagnostic quantity that may be proportionate to the amount and degradation state of the pollution. This approach could also potentially be used by hydrocarbon industries to distinguish between thermogenic vs. biogenic hydrocarbons – as different hydrocarbon mixtures should be linked to different degrading microbial populations. In this way, microbiological assays that target cold-seeps could be used to provide evidence of the source of subsurface hydrocarbons. Our understanding of the interactive effects of environmental pressures on microbes is still in its infancy but it is important to know how they alter the microbial removal of pollutants and how it can be used to diagnose and remediate polluted areas.