Science Foundation Ireland/GSI - Frontiers for the Future

2020

Dr Niamh Cahill - National University of Ireland, Maynooth (NUIM)

Project: Predicting Sea Levels and Sea-Level Extremes for Ireland

Rising seas increase the vulnerability of cities and associated infrastructure that line the coastline of Ireland because of higher extreme sea levels (and flooding), coastal erosion, salinization of surface and ground waters, and degradation of coastal habitats. Armed with statistical knowledge of how sea levels have been changing in the 20th and 21st century, future links between mean sea-level and sea level extremes due to storm surges and wave climate can be established, which are vital to inform decision making related to flood risks.
For this project, we have identified three main components necessary for providing estimates of current and future sea levels and sea level extremes around Ireland: (1) Establish links between sea-levels and climate using instrumental records of Irish sea-level changes; (2) Estimate extreme sea-level probabilities at high spatial resolution for select locations along the Irish coastline considering influences of sea-level rise, storm surges and waves; (3) Combine outputs from (1) and (2) to provide projections of extreme sea levels and corresponding return periods under different climate scenarios. Outputs will contribute to a stakeholder-focused, user-friendly web-application, interactive maps, R software and databases which respond to Ireland's need for future sea-level and extreme sea-level projections and their interpretation.

Duration: 36 months
Total project value: €200,022.00

Dr Michael Stock - Trinity College Dublin (TCD)

Project: Developing a process-based understanding of platinum group element mineralisation: a natural laboratory in Ireland (Critical-Ireland)

Critical-Ireland aims to place fundamental new constraints on the thermodynamic and fluid mechanic processes that generate magmatic platinum group element (PGE) deposits. Due to their essential role in green technologies and concerns over supply security, PGEs constitute 'critical raw materials' which require innovative research to identify new deposits. The Palaeogene igneous intrusions in Ireland have been suggested as one of the most prospective regions for PGE mineralisation in Europe and excellent bedrock exposure, combined with new GSI Tellus data, make them an ideal natural laboratory for investigating PGE mineralising processes. Critical-Ireland will apply state-of-the-art petrographic and geochemical techniques to Palaeogene igneous complexes in Ireland, determining how the dynamics of magma assimilation impact sulphide solubility in mafic intrusions, and how country rock contamination, sulphide accumulation and PGE enrichment vary as a function of thermal and fluid dynamic regime along magma conduits. These new constraints will be used to inform the first dynamic numerical models of PGE mineralising processes, which will aid in understanding deposit formation globally. Critical-Ireland will bring together a unique international research team to place first-order constraints on magmatic processes, which will aid in securing the European PGE supply and unlocking Ireland's potential to produce critical raw materials.

Duration: 48 months
Total project value: €479,055.00

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2019

Dr Juan Diego Rodriguez-Blanco – Trinity College Dublin

Project: SEparating Critical metals ThrOugh mineRal crystallization (SEleCTOR)

The goal of SEleCTOR is to develop novel, clean and cheap protocols to separate rare earths from waters. We will design functionally engineered nanosized carbonates with targeted structures and surface properties that will control the selective capture of specific rare earths from water. Rare earths (e.g., lanthanum, neodymium, dysprosium) are indispensable elements for smart technology and their utilisation is a key economic indicator. However, their supply is at risk in the medium term (2020-2030) because their demand is steadily increasing and their separation requires inefficient, expensive and environmentally aggressive extraction methods. SEleCTOR aims to build a deep, fundamental understanding of how rare earths fractionate during the formation of synthetic Ca-Mg-Sr carbonate nanominerals. By manipulating basic parameters (e.g., supersaturation, Ca/Mg/Sr ratio, pH, temperature) it will be possible to design carbonate nanominerals with targeted structural and surface properties that will promote the capture of specific rare earth elements from aqueous solutions. This method will decrease water contamination and reduce Ireland's reliance on energy imports. I will combine my world-class skills in mineral-water interaction and mineral formation processes with leading knowledge in carbonate and rare earth geochemistry at Trinity College Dublin to establish a unique platform for rare earth recovery.

Duration 48 months
Total project value: €467,646.00

Dr Shane Donohue - University College Dublin

Geophysical and Earth Observation Tools for Evaluating the Condition of Slopes (GEOTECS)

Geotechnical infrastructure elements are essential parts of the transportation and flood defense networks that require sustainable, cost-effective management, while maintaining an appropriate service level to meet social, economic and environmental needs. Recent effects of extreme weather have highlighted their vulnerability to climatic variations, with the resulting failures impacting users, operators, and the wider economy. As climate variations are projected to become more extreme, climate resilient infrastructure is becoming an increasingly important priority. It is therefore crucial that appropriate approaches for assessing condition are developed, so that repairs can be targeted, and failures avoided. Current practice for assessing and monitoring vulnerable geotechnical infrastructure is dominated by visual observations or invasive investigations. These approaches merely confirm poor condition and reinforce responsive practice and do not identify the incremental development of internal conditions that ultimately trigger failure. The GEOTECS project aims to develop tools that are capable of monitoring the condition of infrastructure slopes. GEOTECS will link satellite ground motion data with a novel seismic geophysical approach to (a) identify regional/network scale slope instability (b) forensically analyse the internal properties and processes causing instability at the site scale and (c) monitor the development of these properties and processes, with respect to climate variation.

Duration: 48months
Total project value: €475,379.00