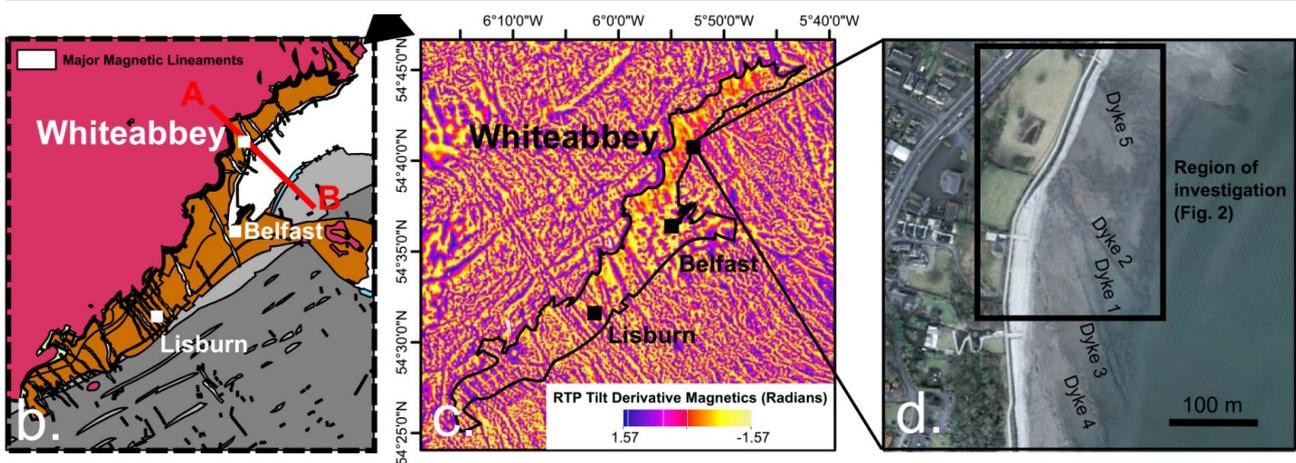


# NC1 Case studies



(b) detailed view of the geology of the Lagan valley with location of major magnetic lineaments from the interpretation of airborne magnetic maps, (c) tilt derivative transformation of airborne magnetic map highlighting magnetic lineaments related to volcanic dyke

swarms, (d) Google Earth aerial photo of the Whiteabbey site showing individual dykes outcropping in the tidal flat.  
Comte, J.-C., Wilson, C., Offerdinger, U., and González-Quirós, A. (2017)

## Case Study 1

# Investigating the groundwater flow regime of the Sherwood Sandstone Aquifer

### Keywords

**Aquifers, agricultural land, habitats, saltwater intrusion, water availability**

**Location:** Sherwood Sandstone Aquifer, Lagan Valley

**Collaborating Organisations:** University of Aberdeen, Université de Neuchâtel (Switzerland) and the Geological Survey of NI

**Date:** 2014–2018

**Project funder:** Study part-funded through Department of Employment and Learning PhD Studentship

**Reported by:** Dr Ulrich Offerdinger, Queen's University Belfast

**Aim:** To evaluate the impact of dolerite dyke intrusions on regional water availability and identify the impact of saline intrusion into the freshwater Sherwood Sandstone aquifer.

## Introduction

This project investigated the groundwater flow regime of the major Sherwood Sandstone Aquifer across the Lagan Valley. Multi-scale geophysical methods<sup>20</sup> were used to improve numerical groundwater flow and transport models.

## Key Research Findings

- Low-permeability structures as small as 1–2 m wide are sufficient to generate preferential pathways and relative aquifer compartmentalisation
- Compartmentalisation of the aquifer with poor connectivity across dykes results in high hydraulic and salinity gradients at dyke locations
- Dykes are shown to act as relative barriers to flow and saltwater transport
- Angle and continuity of dykes inland important factor for freshwater accumulation

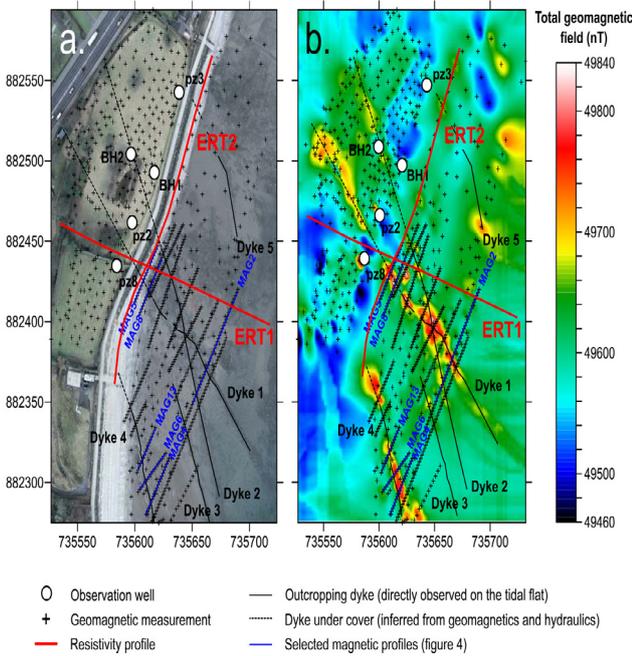
20: Combination of geophysical survey methods applied across varying spatial scales of investigation, including borehole logging methods, ground-based survey methods and airborne or satellite-based geophysical survey methods. Examples include: combining geoelectrical borehole logging methods, measuring formation resistivity at the decimetre scale with ground-based electrical resistivity tomography (ERT) techniques, measuring formation resistivities at scales ranging from the metre to multiples of 100m scale; or combining ground-based electromagnetic (EM) techniques at the metre to 10's metre scale with airborne EM surveying techniques measuring subsurface properties at 10's to 100's metre scale.

Conclusion

Swarms of even relatively thin dolerite dyke intrusions can lead to distinct compartmentalisation of groundwater bodies, affecting the degree of saltwater intrusion and patterns of freshwater accumulation. Geophysical imaging techniques have been shown to be particularly useful in tracing saltwater intrusion and providing parameter values at relevant spatial scales to support numerical groundwater flow models for managing coastal water resources.

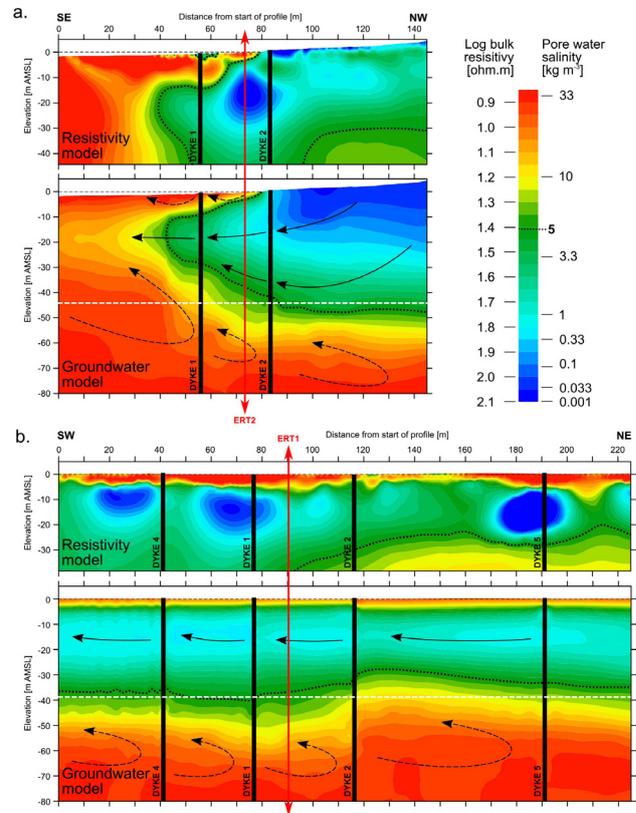
Outcomes

- Study was published in leading international journal (Comte J.C., Wilson C., Offerdinger U., Quiros A., 2017)
- Study findings were provided to Geological Survey of NI and NI Environment Agency as stakeholders and management authorities for Sherwood Sandstone Aquifer
- Study supported both academic research (early career researchers) as well as provided case study for undergraduate and postgraduate teaching



Map of the study site showing the well locations, dyke locations, magnetic profiles and the resistivity profiles (ERT1 & ERT2).

Image credit: Comte, J.-C., Wilson, C., Offerdinger, U., and González-Quirós, A. (2017)



Comparison of inverse Electrical Resistivity Tomography (ERT) models and 3-D groundwater model results illustrating groundwater – salt water interaction in the study area; cross section perpendicular to the shore coinciding with the line ERT1. Black vertical lines are dyke locations and vertical red arrows mark the intersection of the two cross sections (ERT1 & ERT2 below). Black arrow on the groundwater model sections are simplified groundwater flow paths (projected and unscaled); plain arrows for freshwater, dashed arrows for saltwater. The white dashed lines indicate the maximum depth imaged by the ERT profiles.

Image credit: Comte, J.-C., Wilson, C., Offerdinger, U., and González-Quirós, A. (2017)