Results From The Tellus A1 Airborne Electromagnetic Data Near Irish Warm Springs

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INTRODUCTION

Under the framework of the Tellus project (www.tellus.ie), the Geological Survey of Ireland (GSI) completed an Airborne ElectroMagnetic (AEM) survey in Block A1 (**Figure 1**, outlined as grey shaded area) in 2015. The resulting database is regarded as an outstanding opportunity for improving the geophysical subsurface models. As part of the SFI-funded IRETHERM project, an Audio-MagnetoTelluric (AMT) survey was carried out in the St. Gorman's Well area in 2013 (*Blake et al., 2016*).

Frequency-domain AEM data can be imposed as a constraint in the analysis of magnetotelluric data, in order to remove the effects of near surface conductivity anomalies that are not resolved by given AMT profile set up and frequency range used for measurements, but influence AMT responses to greater depths, and thus distorts the images of deeper structures (e.g., *Delhaye et al., 2015*).

In this study, we analyse the AEM data from the St. Gorman's Well area within the Dublin Basin (**Figure 2**) and present the preliminary results obtained using the AEM data, and compare those results with the ones derived from 3-D inversion of the AMT data.
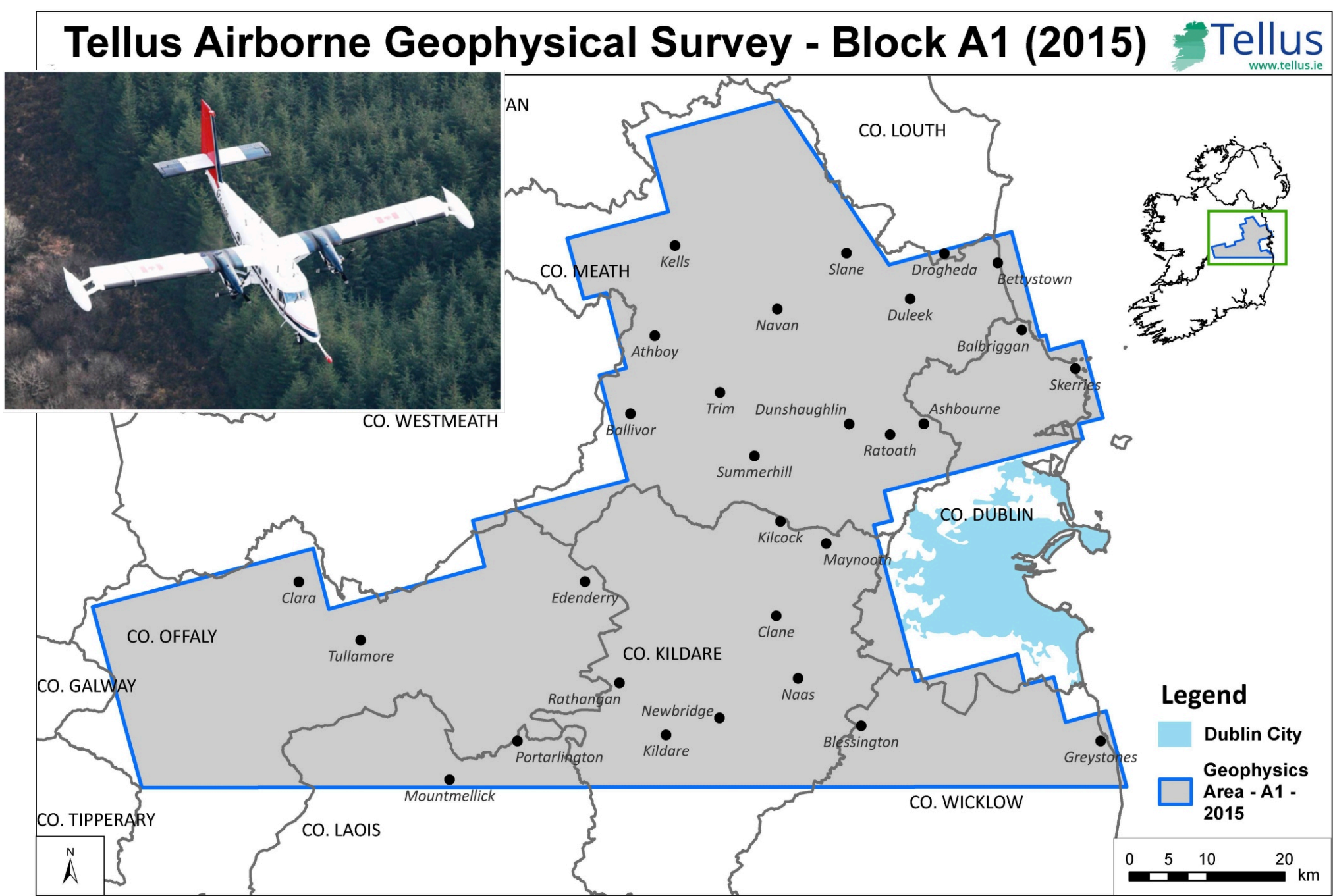

Figure1: Tellus Block A1 airborne geophysical survey area (grey shaded area). Frequency-domain electromagnetic data were acquired using survey aircraft, De Havilland Twin Otter (shown on the top left corner), and NavDAS system developed by Sander Geophysics Ltd. (Hodgson & Ture, 2016). Photo courtesy the Geological Survey of Ireland.
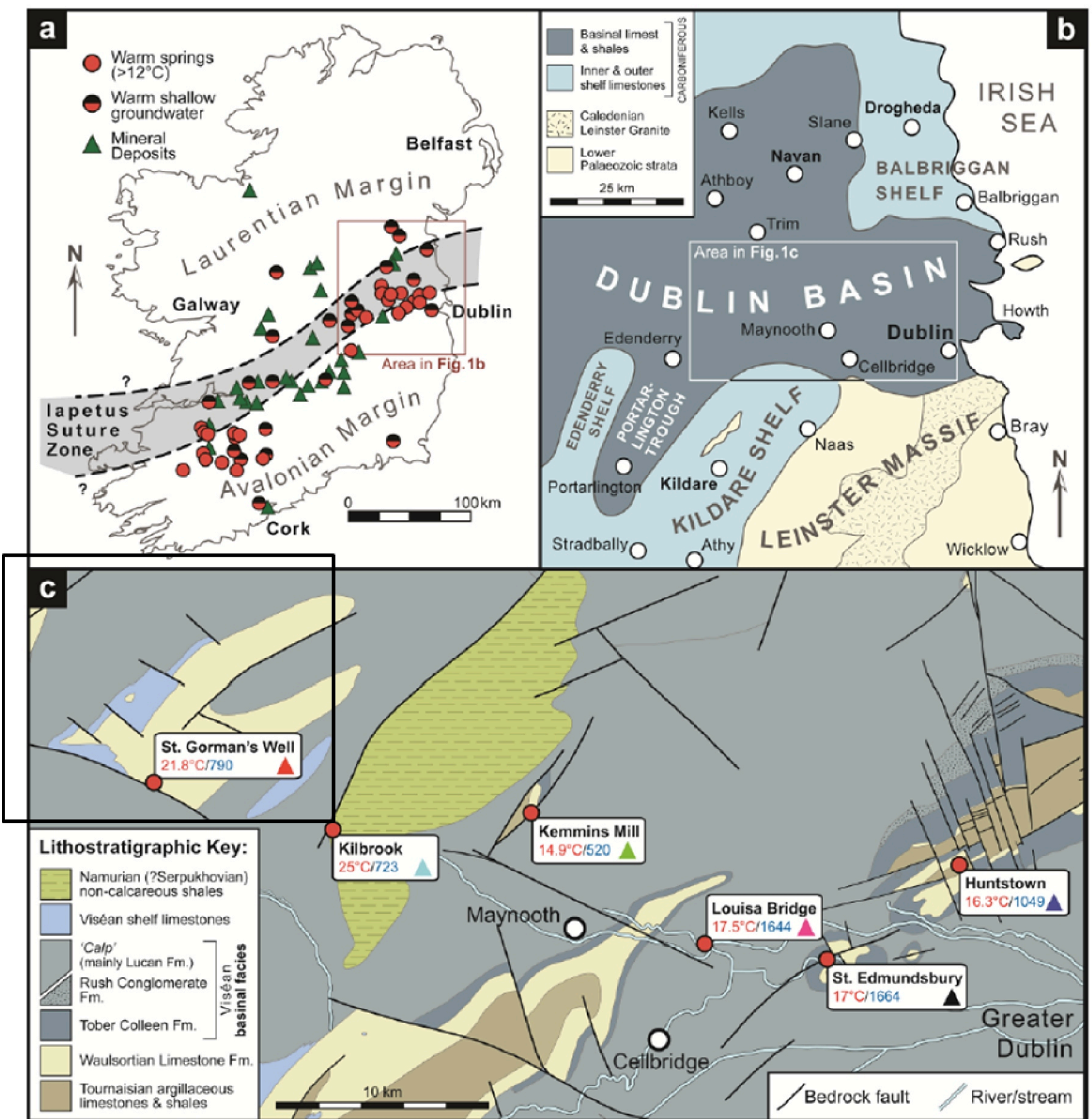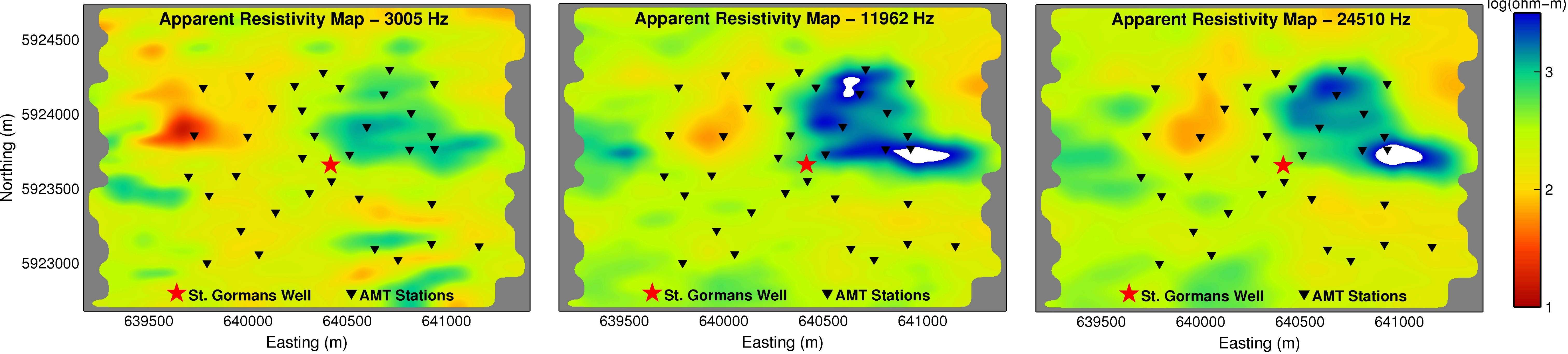

Figure 2: Geological setting of Irish thermal groundwaters (after Blake et al., 2016). Black rectangle in **c** shows investigation area of the study presented here.

AIRBORNE ELECTROMAGNETIC DATA FROM ST. GORMAN'S WELL AREA

Microlevelled apparent resistivity data from the St. Gorman's Well area at three frequencies, 3005 Hz, 11962 Hz, and 24510 Hz are shown on top. The data were smoothed using the nearest neighbor algorithm implemented in the Generic Mapping Tool (GMT) package (*Wessel & Smith, 1991*). White regions on the maps represent data values greater than 5000 ohm-m. In order to be able to compare the AEM data with the AMT resistivity models (**Figure 3**), the smoothing radius of 50 m was chosen. The size of the cells in the 3-D AMT model mesh was set to 50 m by 50 m in the central region of interest. The most striking feature on the maps is the resistive (> 3000 ohm-m) region located in the NE of the St. Gorman's well, which is also imaged on the 3-D AMT slices (**Figure 3**). The resistivity region becomes less pronounced with depth (Map of Apparent Resistivity Data at 3005 Hz). This resistive region can be interpreted as the Waulsortian Limestone Fm., (**Figure 2**, *Blake*

et al., 2016). The NW of the spring is imaged as a relatively low resistivity area (approximately 100 ohm-m), which correlates with the AMT model.

The multifrequency AEM data were inverted using the layered-earth inversion code AIRBEO (*Raiche, 1998*). The 1-D inversion was carried out using both quadrature and in-phase components from 4 frequencies (24510 Hz, 11962 Hz, 3005 Hz, and 912 Hz). The simplest model is a half-space, the results are displayed on the map presented on the right hand-side. This model is in agreement with the geological setting of the study area (**Figure 2c**) and the 3-D AMT model (**Figure 3**). However, a two-layer model could be a more plausible model. AEM inversion for a two-layer will be explored as a next step.
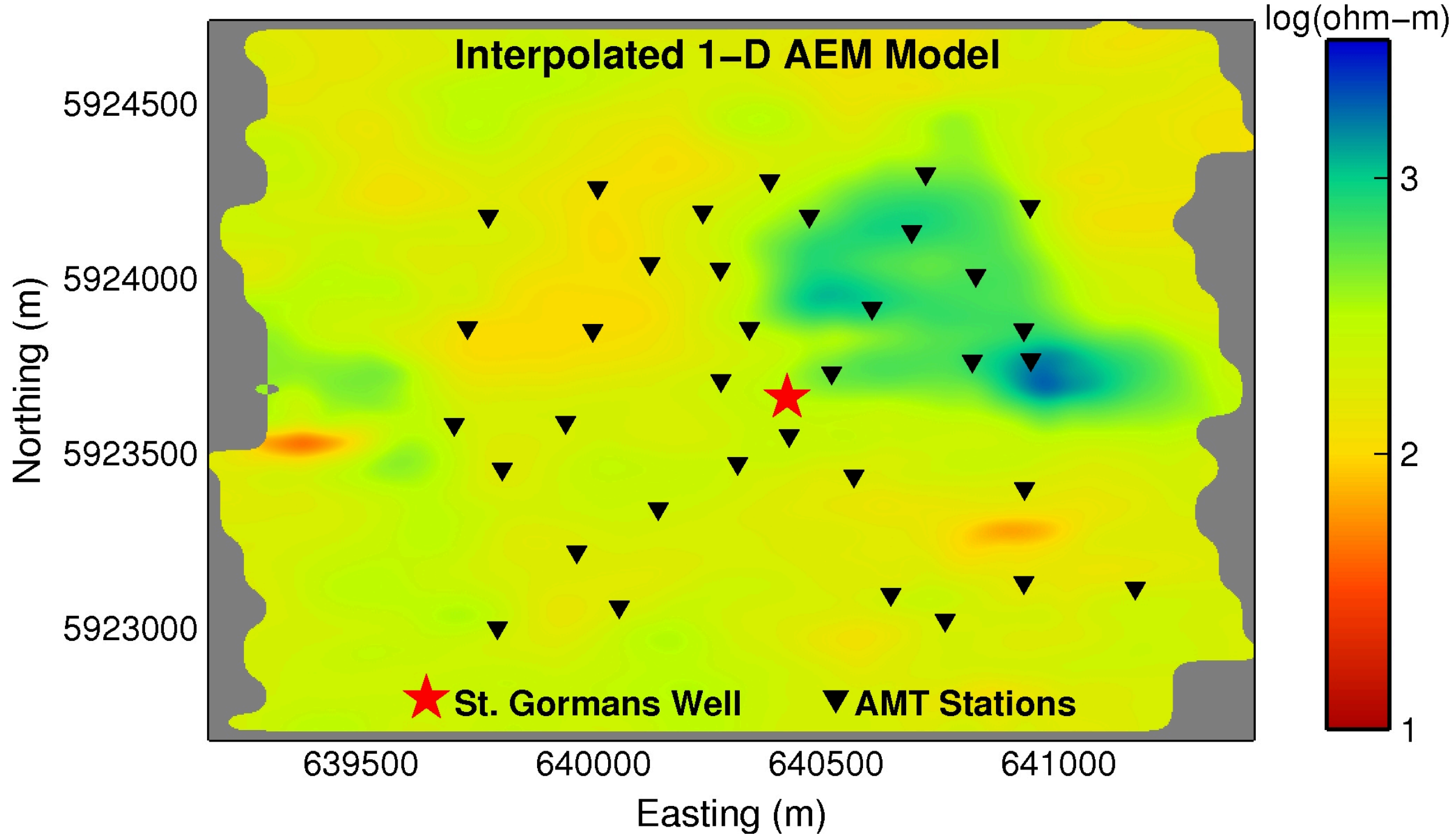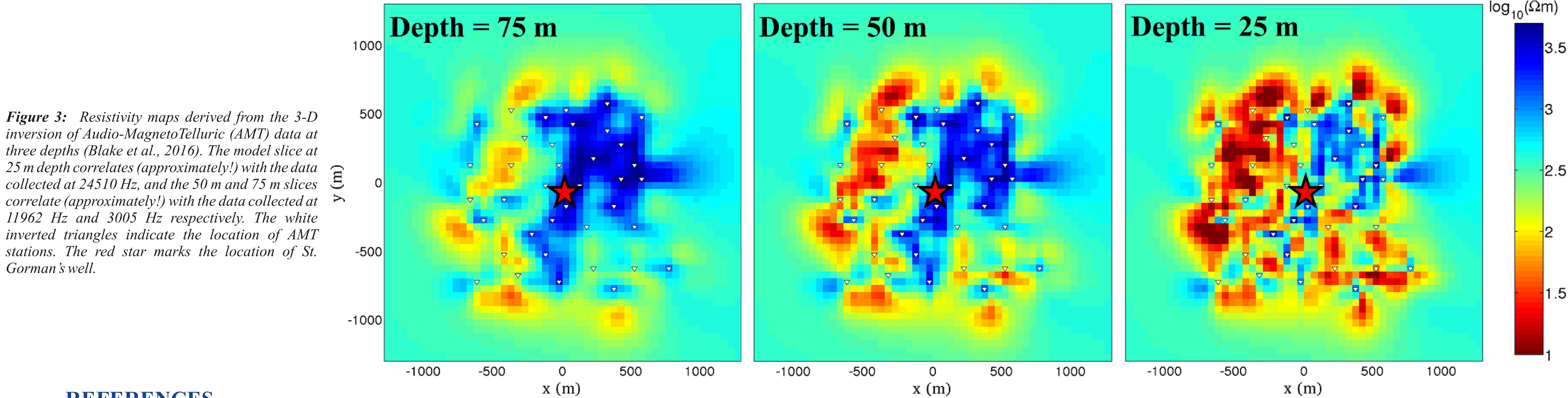

3-D AUDIO-MAGNETOTELLURIC MODEL

Figure 3: Resistivity maps derived from the 3-D inversion of Audio-MagnetoTelluric (AMT) data at three depths (Blake et al., 2016). The model slice at 25 m depth correlates (approximately!) with the data collected at 24510 Hz, and the 50 m and 75 m slices correlate (approximately!) with the data collected at 11962 Hz and 3005 Hz respectively. The white inverted triangles indicate the location of AMT stations. The red star marks the location of St. Gorman's well.

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