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Airborne electromagnetic investigation of the freshwater potential in northern Sumatra after the Tsunami of 2004

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The earthquake at the west coast of northern Sumatra, Indonesia, and the tsunami of 2004 caused the loss of life of a huge number of people and the destruction of houses, basic infrastructure and public facilities. With the tsunami large scale saltwater intrusions crept over the coastal regions and destroyed thousands of shallow water wells. The supply of a sufficient amount of potable water in all populated areas was complicated as many water pipes were broken by the earthquake and a huge number of dug wells were unusable. Many new drillings were not successful in finding potable water due to the lack of information about local hydrogeological conditions. Therefore, the Indonesian and German governments set up a project dedicated to re-install the public life of the people living in the coastal regions of northern Sumatra. The focal point of this ”HELicopter Project ACEH” (HELP ACEH) was water assessment along the shorelines of Aceh. In order to get a fast overview on the remaining freshwater resources and to assist the Indonesian authorities as well as numerous aid organisations in finding suitable locations for drilling new water wells three helicopter-borne surveys including electromagnetics, magnetics and gamma-ray spectrometry were conducted by the airborne group of the German Federal Institute for Geosciences and Natural Resources (BGR) from August to November 2005 (Siemon and Steuer, 2011).

As the mineralisation of water correlates with its electrical conductivity and therefore freshwater and saltwater can be distinguished in general, it was hoped that electromagnetic data would reveal freshwater resources not destroyed by the tsunami, particularly close to the populated coastal areas. The target areas were the city of Banda Aceh with the district of Aceh Besar on the north coast and the area on the west coast between the towns of Calang and Meulaboh in the district of Aceh Barat (Siemon et al., 2007). In addition to that, Coca-Cola Foundation Indonesia (CCFI) funded a further survey on the north-east coast around the town of Sigli in the district of Aceh Pidie (Steuer et al., 2008).

The electromagnetic surveys revealed several potential freshwater resources and areas of saltwater occurrences were mapped in detail. Many requests by aid organisations for information on the local geological and hydrogeological conditions for planned water wells were evaluated and could be successfully answered in most cases. Close to the coasts, however, the investigation depth of the HEM system was constrained due to highly conductive near-surface saltwater and, thus, ground-based time-domain electromagnetic measurements were necessary to reveal deeper coastal freshwater resources. The combination of airborne and ground-based electromagnetic techniques together with a hydrogeological reconnaissance survey increased the efficiency to estimate the freshwater potential. The airborne geophysical surveys helped to close the gaps between task-force measures and long-term planning as well as between spatial surface mapping and local borehole data. Particularly airborne electromagnetics proved to be a very efficient tool to supply hydrogeological baseline data for rehabilitation programs.

References:

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