Airborne and ground-based transient electromagnetic mapping of groundwater salinity in the Machile–Zambezi Basin, southwestern Zambia

The geological and morphological evolution of the Kalahari Basin of Southern Africa has given rise to a complex hydrogeological regime that is affected by water quality issues. Among these concerns is the occurrence of saline groundwater. Airborne and ground-based electromagnetic surveying is an efficient tool for mapping groundwater quality variations and has been used extensively to explore the Kalahari sediments, e.g., in Botswana and Namibia. Recently, airborne and ground-based mapping of groundwater salinity was conducted in the Machile–Zambezi Basin, southwestern Zambia, using the versatile time-domain electromagnetic system and WalkTEM system, respectively, incorporating earlier ground-based ProTEM 47D measurements. The data were inverted using the laterally constrained inversion technique followed by a separate spatially constrained inversion scheme. WalkTEM data were inverted as ordinary single-site one-dimensional inversions. The regional electrical resistivity signature of the Machile–Zambezi Basin was found to be characterized by high elevation (1000 m–1050 m above mean sea level), high electrical resistivity (above 100 Ωm) areas that form the western and eastern boundaries of a low-resistivity (below 13 Ωm) valley that extends southwestwards into the Makgadikgadi salt pans. The electrical resistivity distribution is indicative of a full graben related to the Okavango–Linyati Fault system as a result of propagation of the East African Rift Valley System into Southern Africa. The saline lacustrine sediments infilling the Machile Graben are responsible for the low formation resistivity (below 13 Ωm) and high salinity (above 7000 µS/cm) observed in the groundwater and are probably related to the complex evolutionary history of Palaeo-Lake Makgadikgadi.

General Information
State: Published
Organisations: Department of Environmental Engineering, Water Resources Engineering, University of Zambia, Aarhus University, Geological Survey of Denmark and Greenland
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Pages: 383-396
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Near Surface Geophysics
Volume: 13
Issue number: 4
ISSN (Print): 1569-4445
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.43 SJR 0.436 SNIP 0.972
Web of Science (2017): Impact factor 1.186
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.15 SJR 0.593 SNIP 0.833
Web of Science (2016): Impact factor 1.293
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.5 SJR 0.83 SNIP 0.846
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.4 SJR 0.809 SNIP 1.079
Web of Science (2014): Impact factor 1.179
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.73 SNIP 0.861
Web of Science (2013): Impact factor 1.01
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.51 SJR 0.859 SNIP 0.977
Web of Science (2012): Impact factor 1.123
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 0.93 SJR 0.773 SNIP 0.705
Web of Science (2011): Impact factor 0.945
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.668 SNIP 1.114
Web of Science (2010): Impact factor 0.989
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.49 SNIP 0.79
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.575 SNIP 1.116
Scopus rating (2007): SJR 0.54 SNIP 1.246
Original language: English
Electronic versions:
DOIs:
10.3997/1873-0604.2015024
Research output: Research - peer-review › Journal article – Annual report year: 2015