

# Systematic groundwater investigation in selected sites of the Ethiopian Rift: Towards an understanding of the Hydrogeology of the Rift and Adjacent Highlands

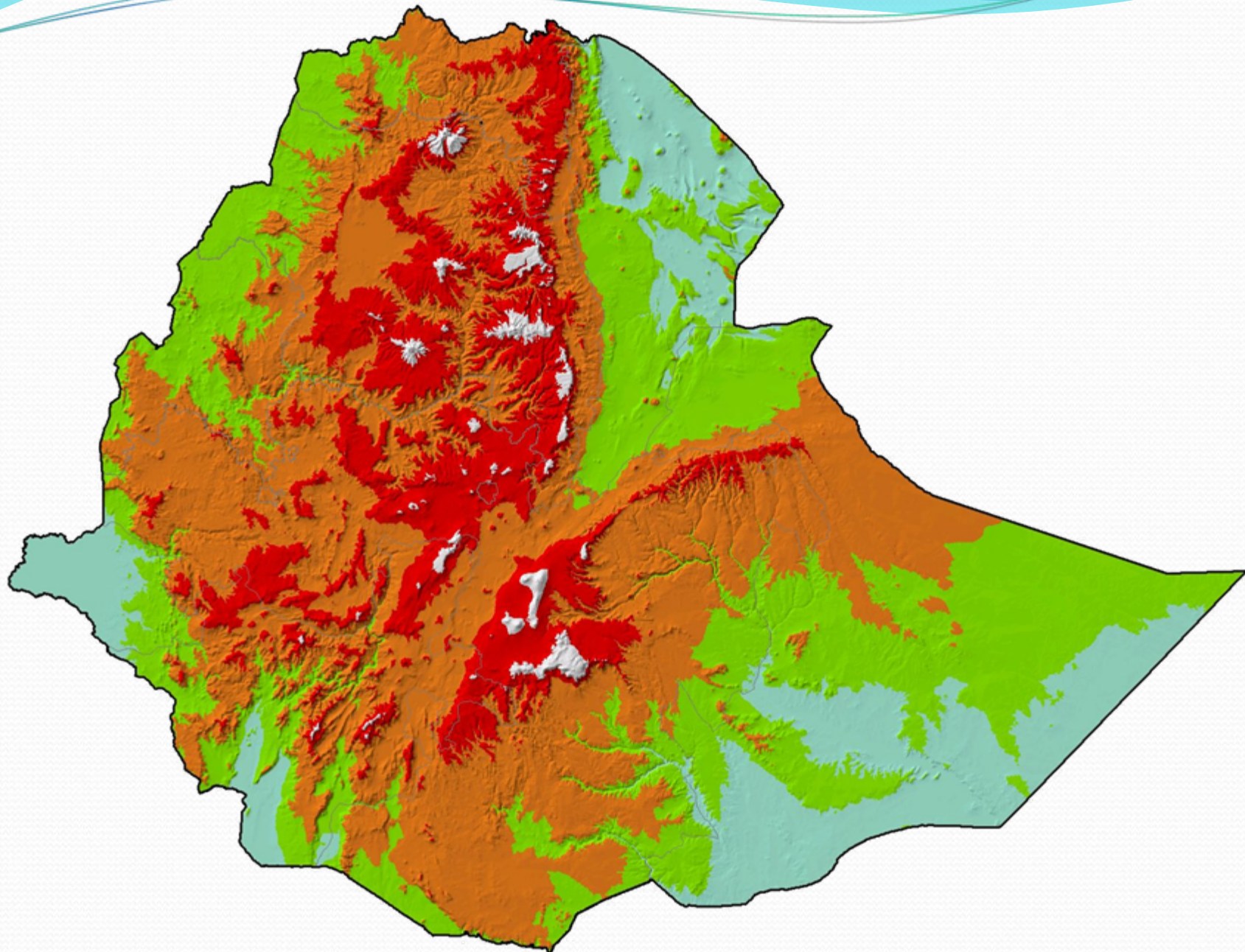
MAWARI Project  
Annual Scientific Meetings  
(20 - 24 November, 2007)



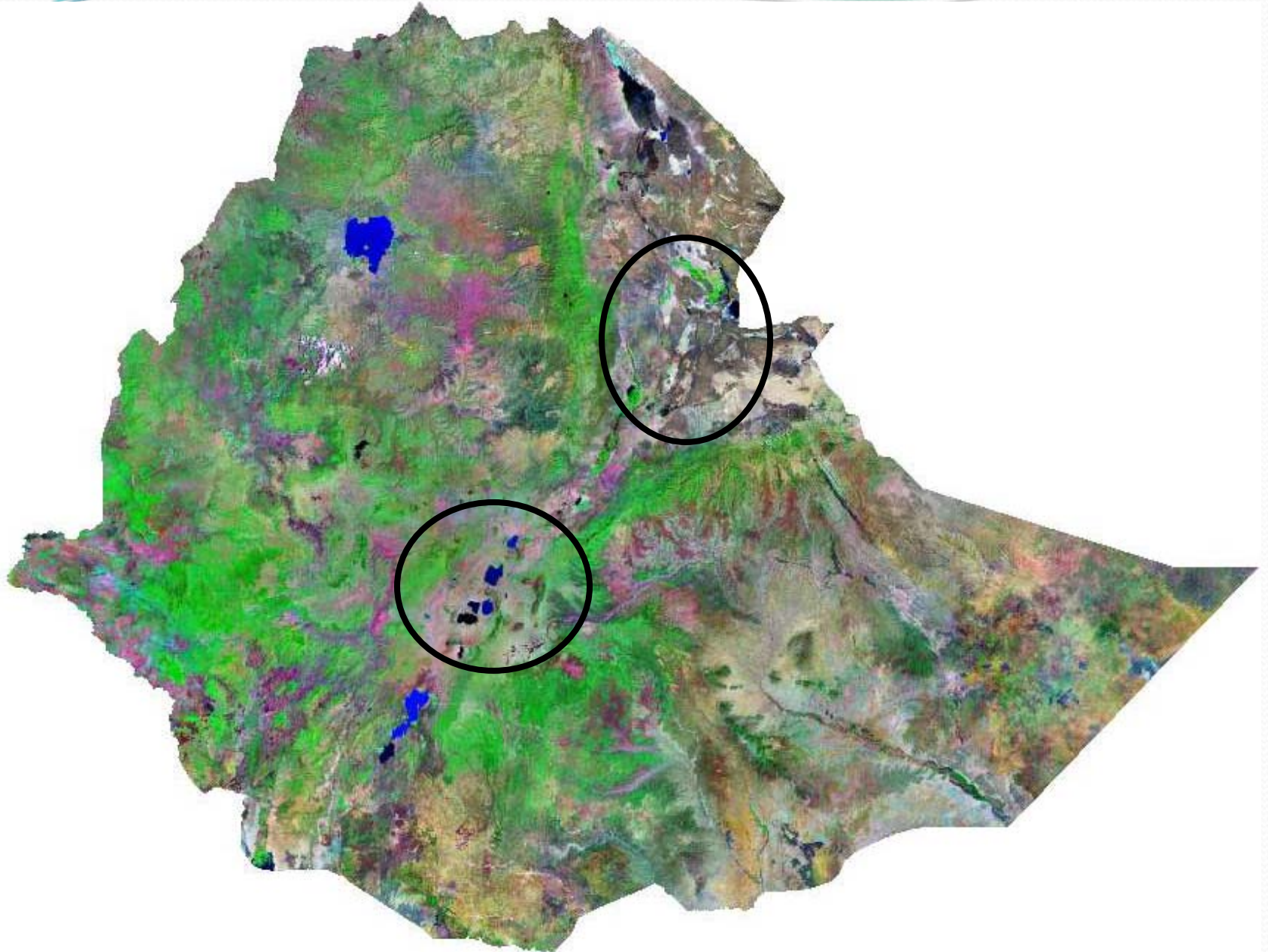
# Background

- The main Ethiopian Rift
  - Groundwater is the main source of water supply
  - Geologically complex and hence the occurrence, circulation and distribution of groundwater is not yet well defined
  - Groundwater is unfit for use (chemically enriched especially with Fluoride)
  - Development and demographic pressure is increasing
  - Groundwater-surface water interaction not well-defined

# DEM : Ethiopia



# Satellite Images: Ethiopia



# The MaWaRi Project

## **Objectives of the project:**

to contribute to the improvement of knowledge and understanding of the groundwater life cycle

to set guidelines to help decision makers for a sustainable management of the water resources in the Rift valley.

(Djibouti, Ethiopia and Kenya)



# The MAWARI Project

- Financed by French MoFA
- Administrative Support by CIFEG
- Members- Djibouti, Ethiopia and Kenyan hydro(geo)logical scientists

# The MAWARI Project in Ethiopia

- The Floride Project

Origin, genesis and distribution of fluoride in the Ethiopian Rift and development of defluoridation technologies.

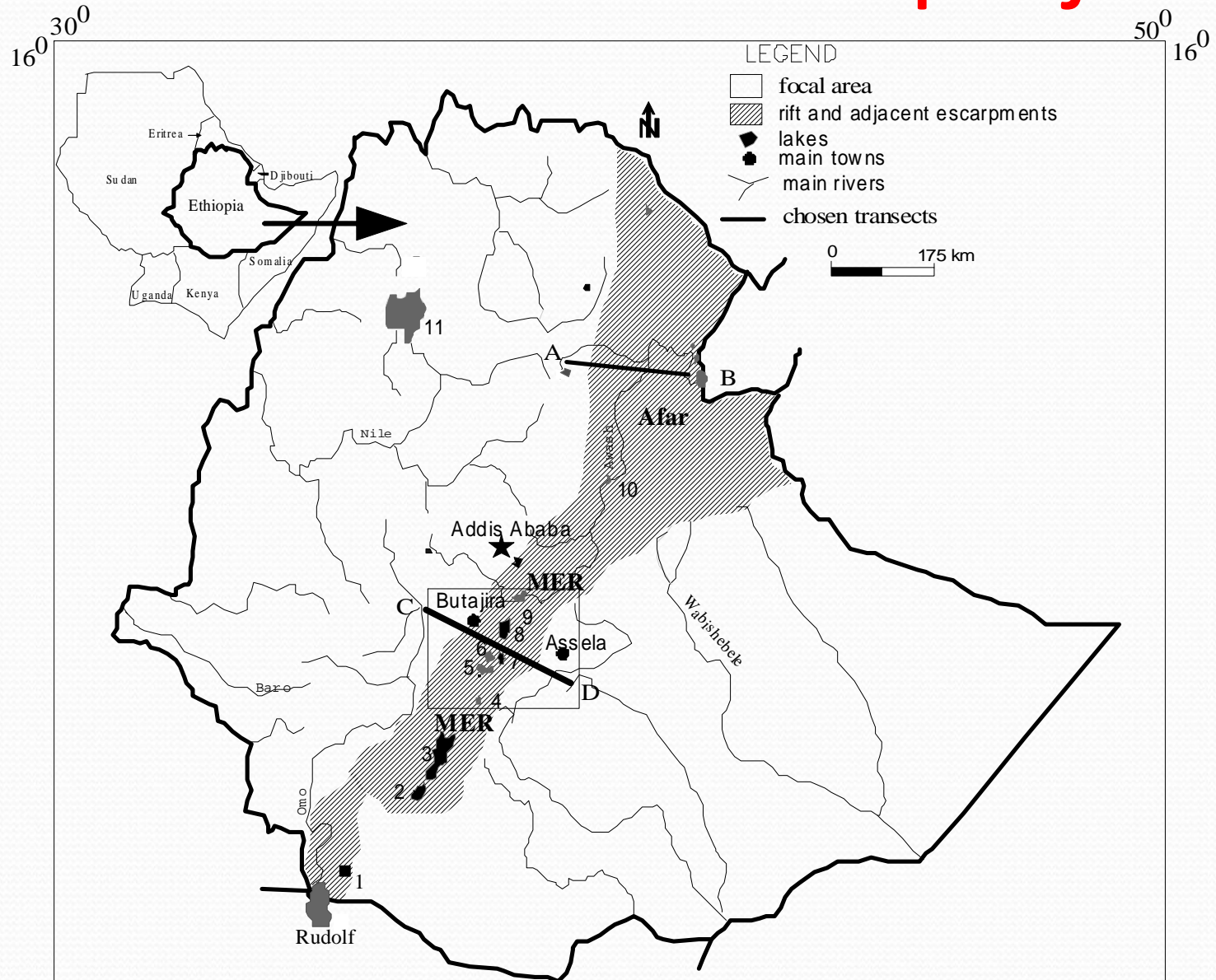
- The Transect Project

Systematic groundwater investigation in selected sites of the Ethiopian rift: towards an understanding of the hydrogeology of the rift and adjacent highlands

# The MaWaRi Transect project

- The Transect project examines hydrologic, hydrogeologic and hydro-geochemical processes from the slope of the highest peak in the Awash watershed to the deepest circulating groundwater in the Afar depression (section A-B) and along the transect of the MER between the western and eastern highlands crossing the MER (section C-D).

# The MaWaRi Transect project



Lakes: 1) Chew Bahir 2) Chamo 3) Abaya 4) Awassa-Cheleleka 5) Shala 6) Abiyata 7) Langano 8) Ziway 9) Koka 10) Beseka 11) Tana

# Objectives

- To understand the occurrence and distribution of groundwater in the rift and assess its role in the water balance of the rift lakes and identify large aquifer systems, which can be used by the rural and urban community that are short of potable water due to unfavorable hydrogeological conditions and bad water quality.
- To investigate recharge processes, depths of groundwater circulation, geochemical evolution, flow direction, inter-basin water transfer, groundwater flow dynamics and continuity along two geo-hydrologically representative sectors of the Plateau-Rift transects.

# Research Questions

- What is the temporal pattern of recharge: can at least part of it be regarded as quasi-steady instead of intermittent?
- What are the percentage contributions of stream loss, vertical infiltration through soils, recharge from mountain body, paleo-water recharge?
- What is the role of marginal grabens, transverse and bounding faults in controlling groundwater transfer?
- What is the pattern of shallow and deep flow paths and residence times within typical mountain blocks? How do the hydrogeologic characteristics of mountain blocks, and the stream network geometry, affect these patterns?
- Are faults and tectonic structures responsible for facilitating groundwater transfer between uplands and lowlands or are they responsible for rejection of recharge water before they reach the rift valley aquifers and lakes?
- Where are the major aquifers and how does groundwater be localized? Which places are suitable for groundwater development (identification and potential evaluation of aquifers)?
- What is the role of groundwater in the water balance of the rift lakes?
- What is the subsurface hydraulic connection of the rift lakes? Which lakes feed the groundwater system and vice versa?
- Does the unsteady state groundwater flux (outflow and inflow) affect the fluctuation of the lakes?
- How does natural (climatic, neotectonism) and anthropogenic factors (land use changes, water diversion and pumping) affect the groundwater recharge and the hydrogeological regime?
- Is the quality of the groundwater suitable for various uses (community water supply and irrigation)?
- Is there noticeable water pollution from municipal, industrial and agricultural sources?

# Major Expected outputs

- detailed result that can readily be used for groundwater drilling operations, aquifer and lake watershed management which will lead to sustainable and environmentally sound water resources utilization practises.
- Capacity building

# Methodology

- **Systematic hydro-meteorological data analysis**
- **Recharge estimation and soil-water balance modelling**
- **Groundwater modeling**
- **Conventional geological and hydrogeological mapping**
- **Isotope and hydrochemical analysis**
- **Geophysical method**
- **Remote sensing and GIS techniques**

# Manpower

Four Staff members from AAU Earth Sciences Department:

- Tamiru Alemayehu, Hydrogeologist
- Tenalem Ayenew, Hydrogeologist
- Dagnachew Legesse, Hydrologist and GIS/RS specialist
- Seifu Kebede, Hydrogeologist
- Tigistu Haile, Geophysicist
- Shimelis Fisseha, Geophysicist
- Bekele Abebe, Structural Geologist
- Tesfaye Kidane, Structural Geologist
- Mohammed Ummer, Environmentalist and paleo scientist

# Collaborators

## **National**

- AAU
- Geological Survey of Ethiopia
- Ministry of Water Resources
- National Meteorological Services Agency

## **International**

- University of Avignon
- University of Poitiers
- University of Brest
- CEREGE

# PhD Titles

**Andarge Yitbarek:** (Univ. Of Poitiers)

Lithostratigraphical set up, Groundwater Recharge, Circulation and Chemistry in the Plateau-Rift Interface Volcanic Aquifers of Upper Awash Basin, Central Ethiopia

**Wakgari Furi:** (Univ. Of Poitiers)

Hydrogeological System Analysis of Middle Awash Basin

**Hawi Abate:** (Univ. Of Brest)

Near surface soil moisture assessment and its influence on regional scale heat fluxes, Awash basin

# Students (MSc)

Mesay Tefera	An integrated hydrological and hydrogeological system analysis in parts of the Main Ethiopian Rift
Kumo Kedir	Model based groundwater flow system analysis of the catchment
Shemelis Fikre	
Nardos Tilahun	
Alemu Deribsa	Groundwater – Surface water interaction and analysis of hydroenvironmental dynamics in catchment
Aychluhim Debebe	Integrated water resources potential investigation of the weybo river catchment, Welayita-Hadiya Zone, SNNPR

Name	Thesis Title	stream
Tibebu Terefe	Groundwater utilization from lacustrine aquifer of Ziway and its impact on groundwater balance	Hydrogeology
Abiyu Kebede	Interaction between the lakes region and the Koka basin	Hydrogeology
Haile Asrat	Land use impact on water quality in the Main Ethiopian Rift	Hydrogeology
Mulugeta Mussie	Hydrogeological nature at at Gidabo-Awassa basin boundary	Hydrogeology
Hawi Abate	Hydrological modeling of Meki river basin	GIS & Remote Sensing
Binyam Tesfaw	Lineament analysis around	GIS & Remote Sensing
Fekadu Tamiru	Application of Gravity and magnetic method at the Koka basin and Central Rift valley	Geophysics

# GEOPHYSICS (2007-2008)

- Works on progress and planned works
  1. Tagel Assefa, Gravity, Magnetic and Electrical Methods to Map Possible Connections between Lakes Langano-Shala, MSc
  2. Eyasu Solomon, Sodere Thermal Spring Area, Thermal and Groundwater Resources, MSc
  3. Solomon Tadesse, Groundwater Potential of Arsi Negelle Area, MSc (out of the program, travelled abroad)
  4. Tigistu Haile and Shemelis Fisseha, Ziway-Butajira Area, work in collaboration with Drs. Seifu and Asfawossen
  5. Tewodros Solomon, Groundwater Resources, Wonji-Bulbula Area, MSc
- Acquiring the IRIS Imaging Instrument and Training- to include personnel from Geophysical Observatory, GSE, Min of Water Resources, etc...
- Mawari Geophysics Workshop

# List of Publications


- Tenalem Ayenew and Nardos Tilahun, 2007. Assessment of lake - groundwater interaction and anthropogenic stresses using numerical groundwater flow model in rift lake catchment, central Ethiopia. *Journal of Environmental Geology* (accepted)
- Seifu Kebede, Yves Travi, Asfawossen Asrat, Tamiru Alemayehu, Tena lem Ayenew and Zenaw Tessema Groundwater origin and flow along selected transects in Ethiopian rift volcanic aquifers, *Hydrogeology journal*,
- Tenalem Ayenew , 2007. Hydrogeological controls and distribution of fluoride in the groundwaters of the central Main Ethiopian rift and adjacent highlands. *Environmental geology*
- Tenalem Ayenew and Dagnachew Legesse (2007). The changing face of the Ethiopian rift lakes: Call of the time. *Lakes and reservoirs: research and mangament*. 12 (3): 149-165
- Tenalem Ayenew and Shimelis Fikre, 2007. Herarchical cluster analysis of hydrochemical data as a tool for assessing the evolution and dynamics of groundwater across tectonically active-rift valley. *Journal of hydrology* (submitted).
- Dagnachew Legesse and Hawi Abate (Manuscript) Hydrological modeling of the Meki Catchment,

# Major Purchase

- Laboratory Chemicals
- Satellite images
- Resistivity meter
- Laptop computer

# Future Plans

- Integrating the major findings from the various methodologies.
- Preparing manuscripts of major findings for publication in international journals.
- Purchasing some chemicals and replacement parts for the Hydrogeology laboratory of Earth Sciences Department of AAU.
- Reinforcing the RS/GIS lab of the Department through purchase of one good capacity server computer and other accessories.

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- Completing the work of the three PhD students
  - Recruiting more MSc students