

Michigan State University

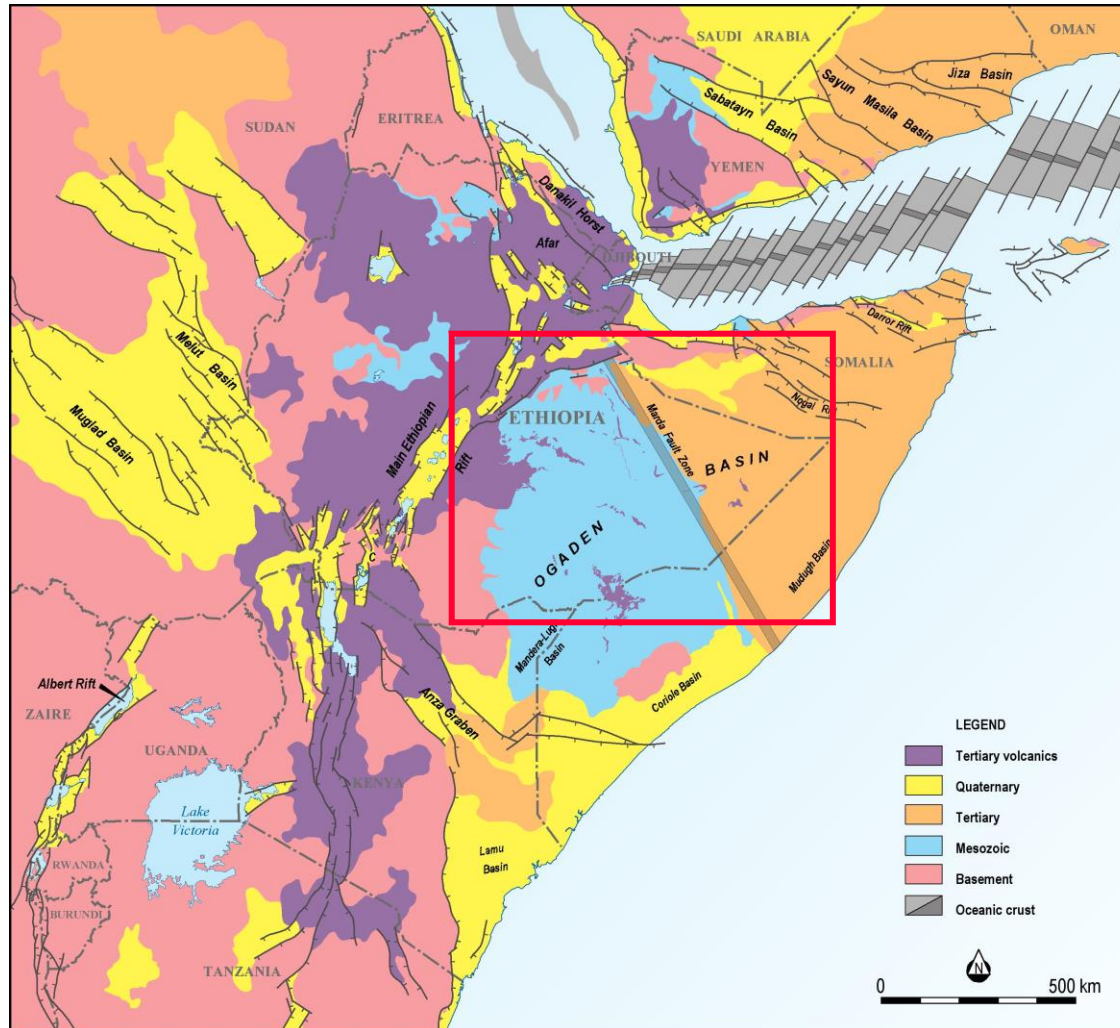
*Revised mapping and dating of Cainozoic volcanics southeast
of Afar and the Main Ethiopian Rift*

*Peter Purcell, Daniel Mege, Tyrone Rooney, Jacques-Marie Bardintzeff,
Fred Jourdan & Gezahegn Yirgu*



Dr Daniel Mege, University of Nantes, eastern Ogaden, 2008

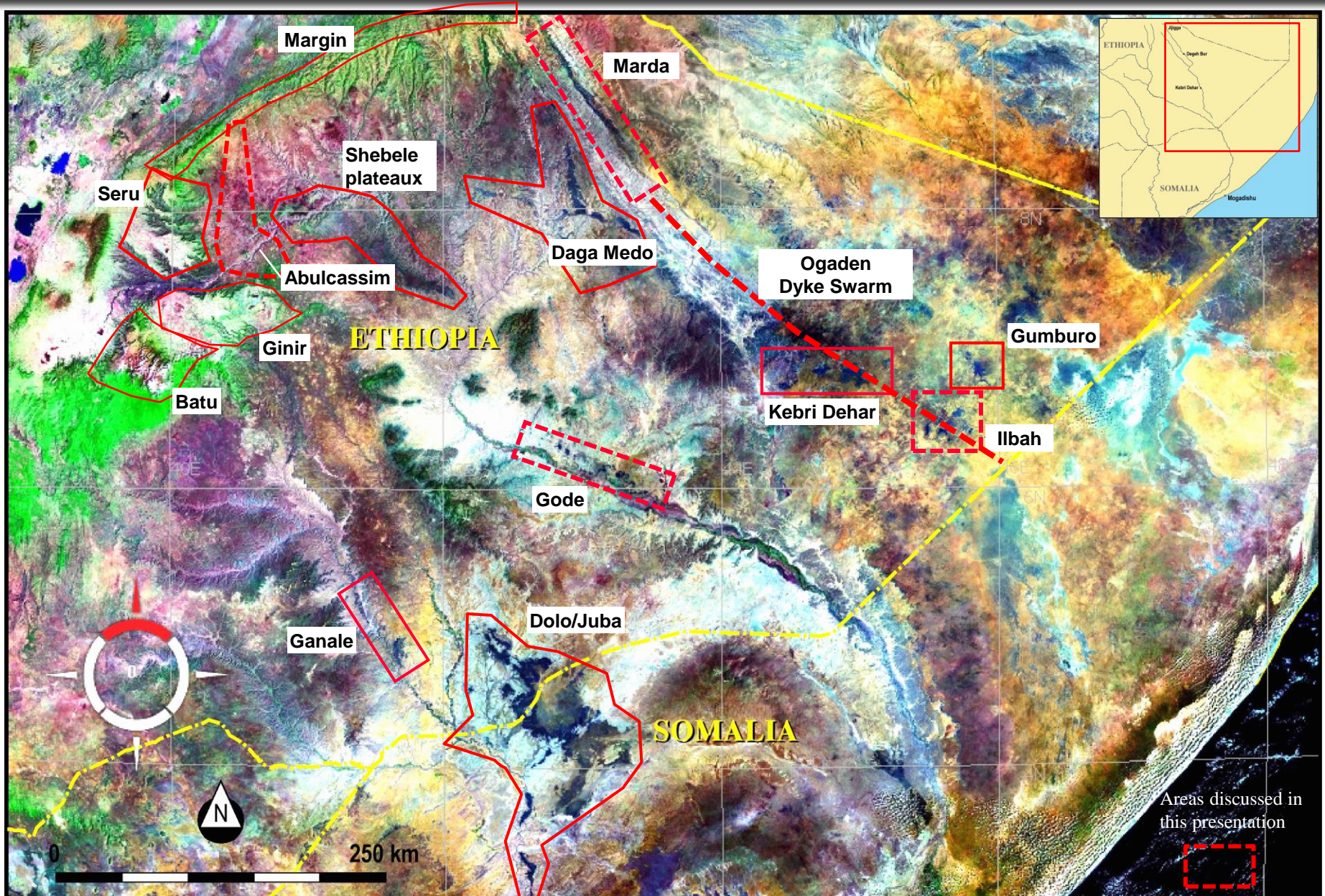
1. Introduction
2. Description of Marda Project
3. Discuss selected volcanic complexes
 - i. Gode paleovalley-filling flow
 - ii. Marda tectono-volcanic lineament
 - iii. Ogaden Dyke Swarm
 - iv. Abulcassim intrusive complex
4. New $\text{Ar}^{40}/\text{Ar}^{39}$ dates
5. Geochemical analyses
6. Status of project



- The volcanic geomorphology of Ethiopia is asymmetrical relative to the Ethiopian Rift Valley and Afar
- Tertiary volcanics are aurally and volumetrically much larger on the western side of the rift, where they have been studied far more extensively
- The surface of the Ethiopian Plateau is mostly volcanics or Precambrian basement rocks, by contrast to the Mesozoic and Tertiary sediments which characterize the Somalian Plateau and Ogaden region.

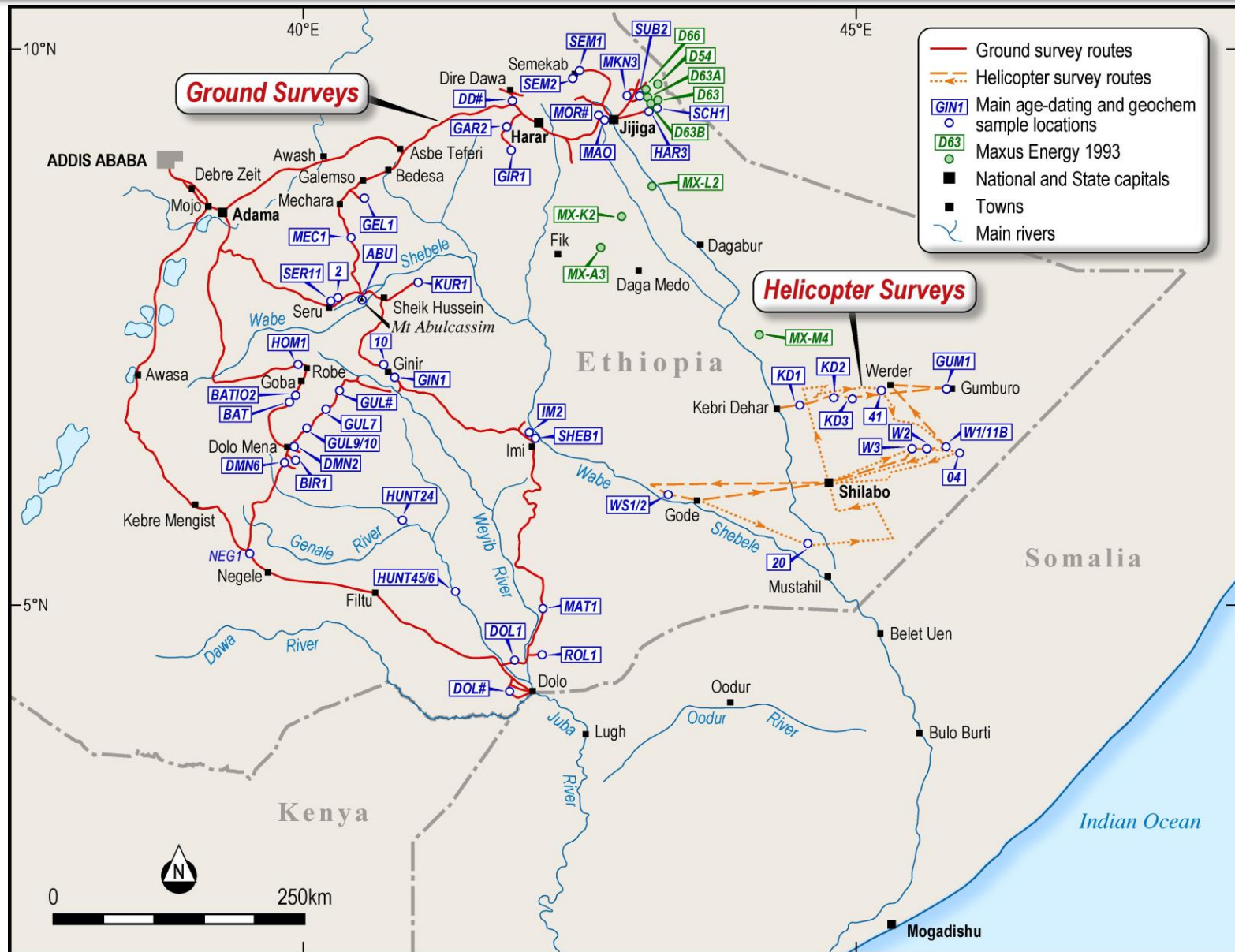
ETM image, showing volcanic complexes

P&R



Survey routes and station locations, 2008-16

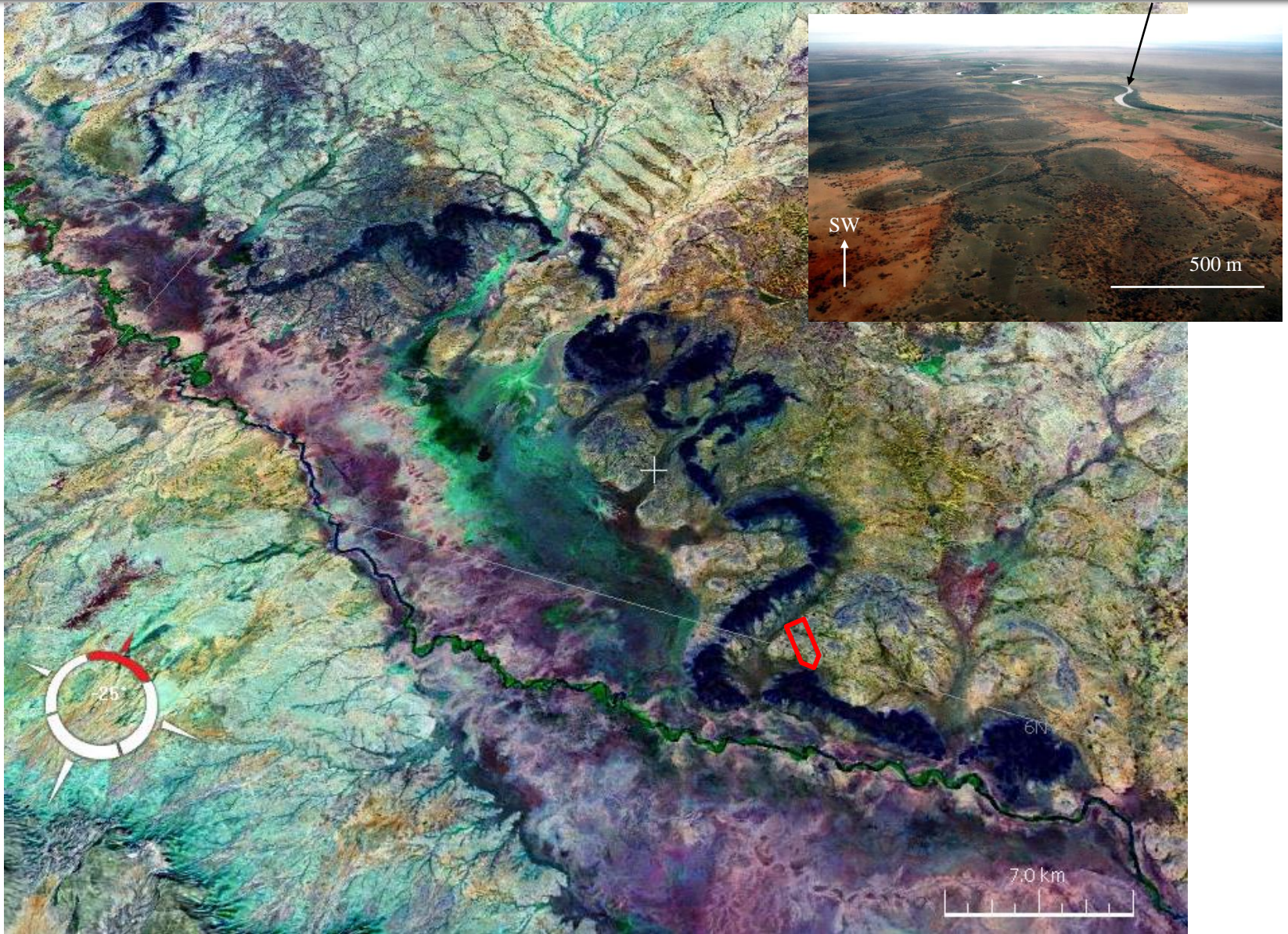
P&R





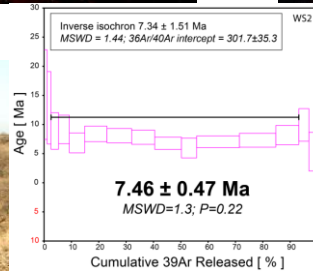
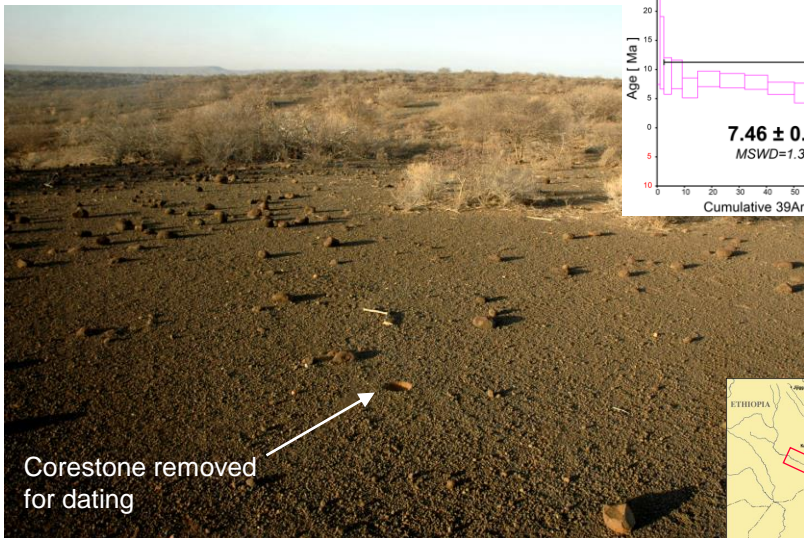
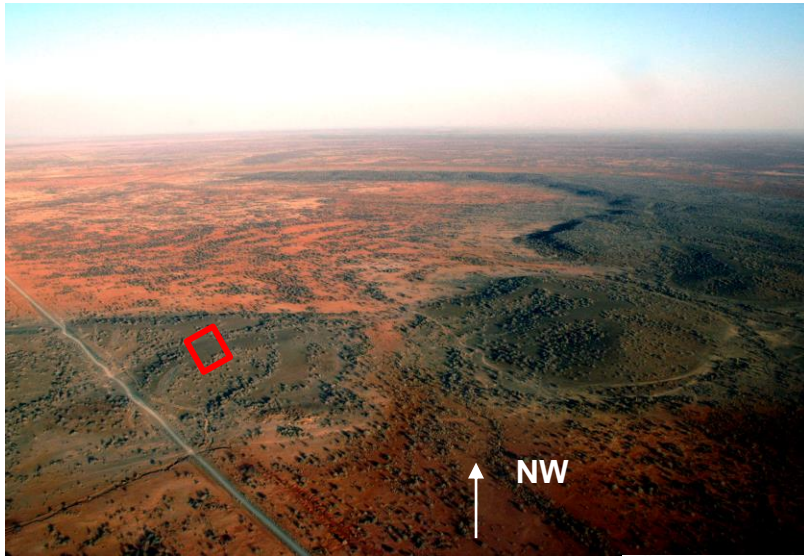
Gode flow in ancestral Wabe Shebele

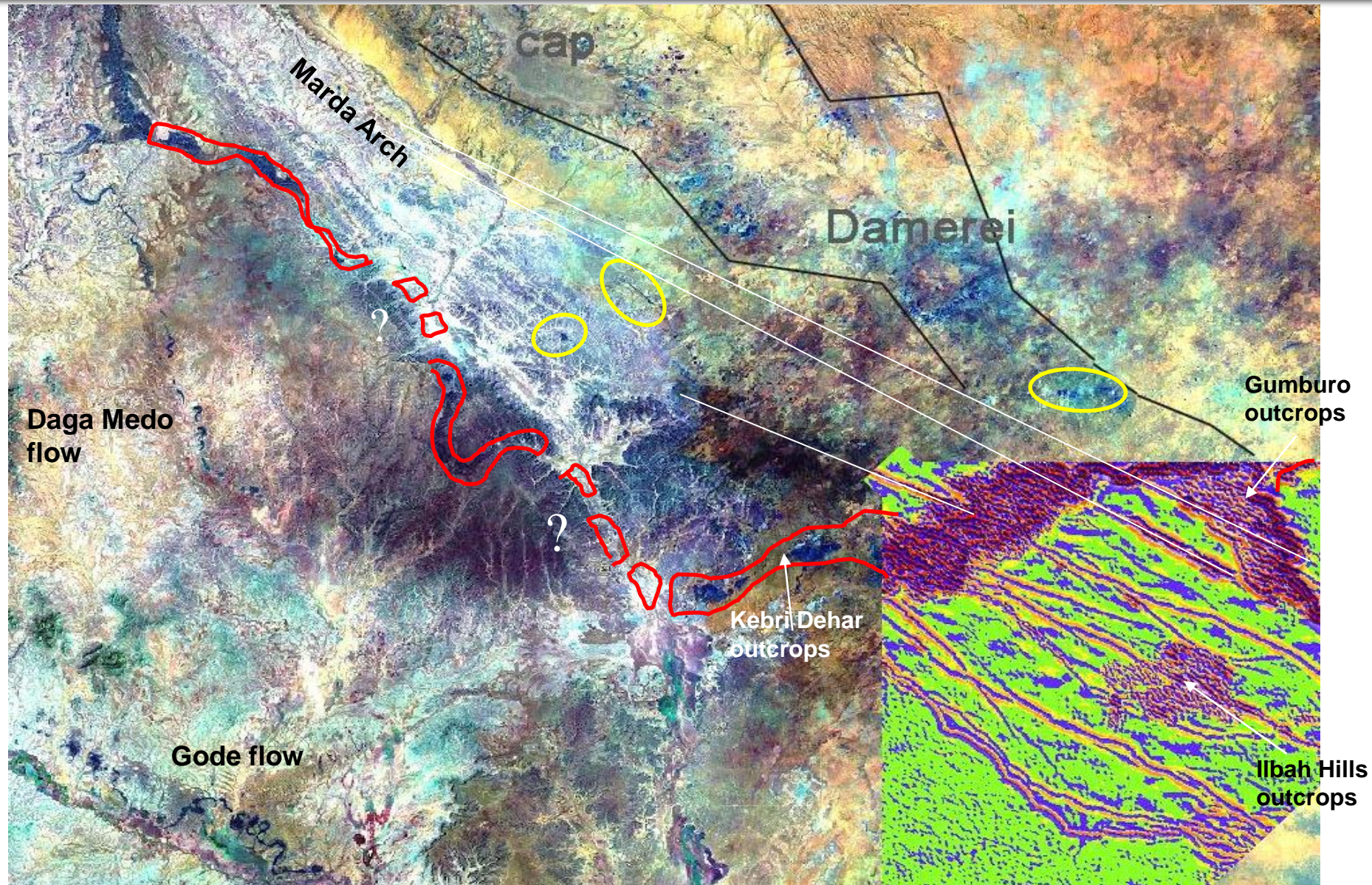
P&R



Ancestral Wabi Shebele canyon-fill

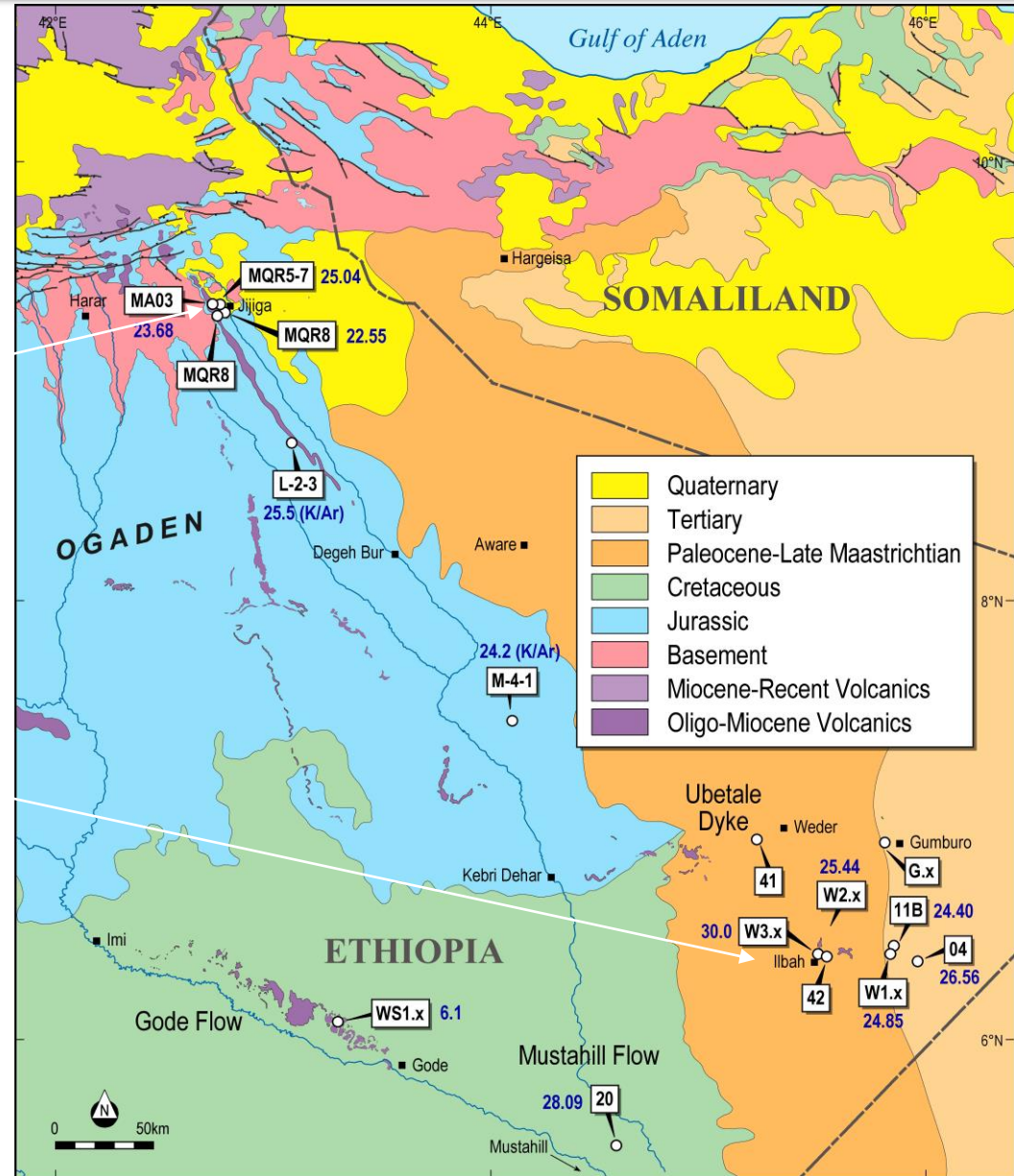
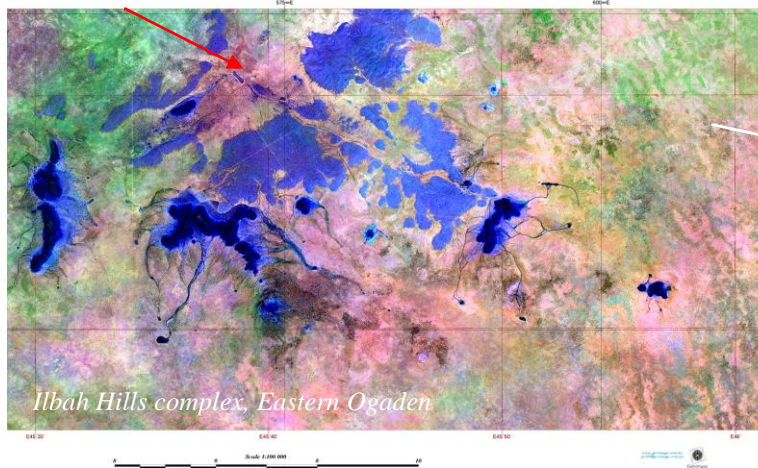
P&R





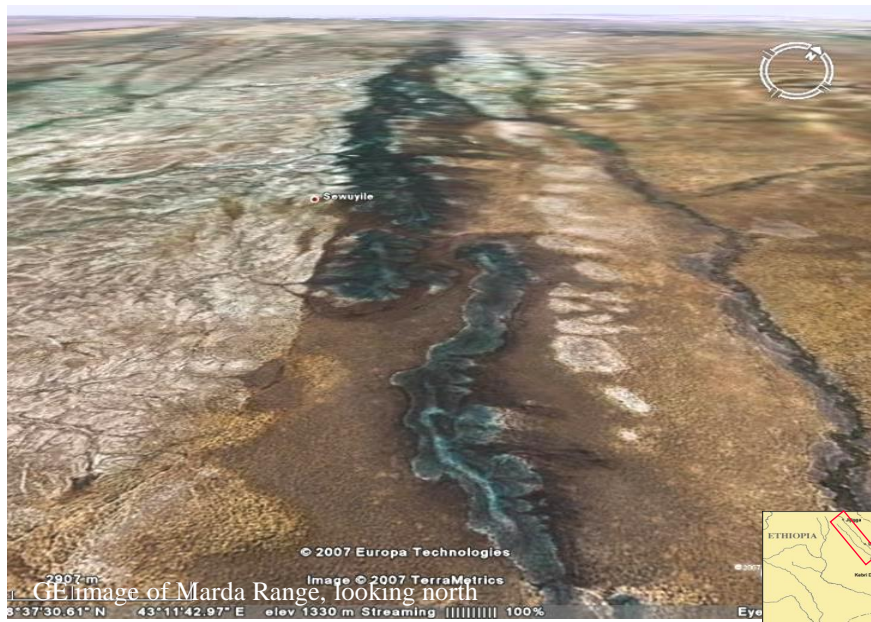
Marda Range and Ilbah Hills volcanic complexes

P&R



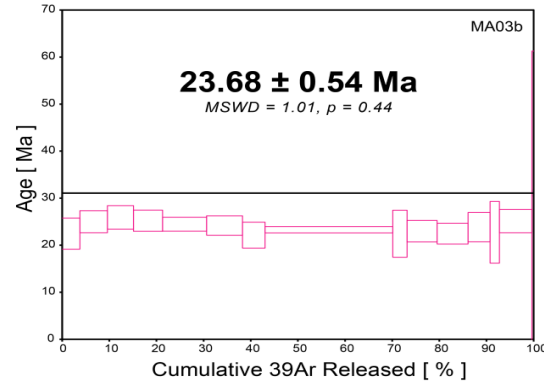
Marda volcanic lineament

P&R

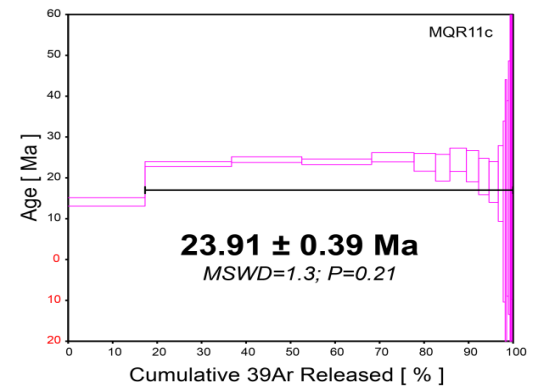
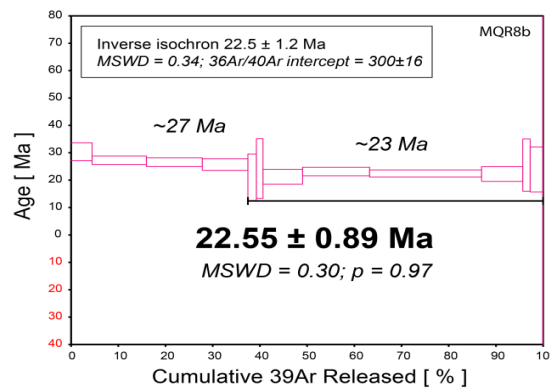


Ar/Ar dating of Marda Range intrusions

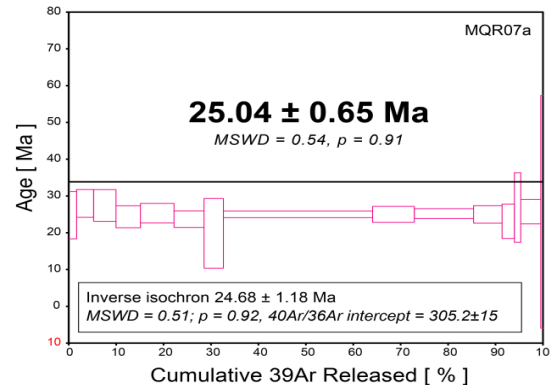
P&R



basaltic sill



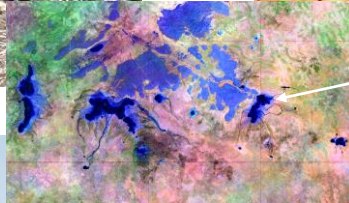
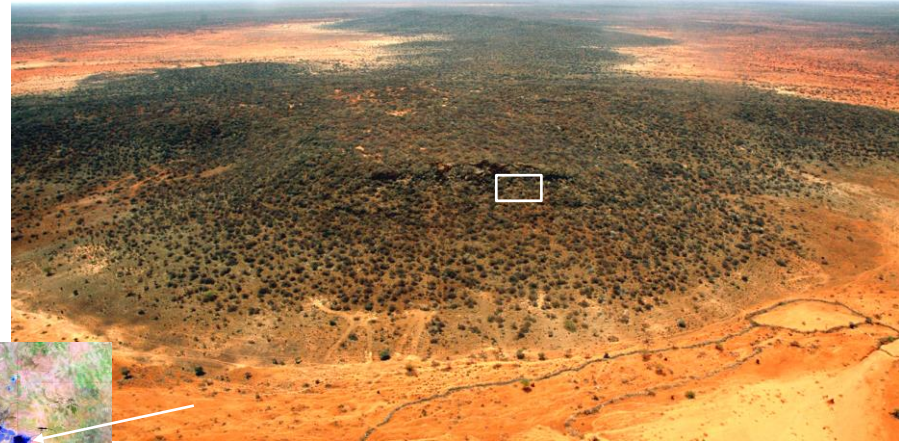
dolerite intrusives

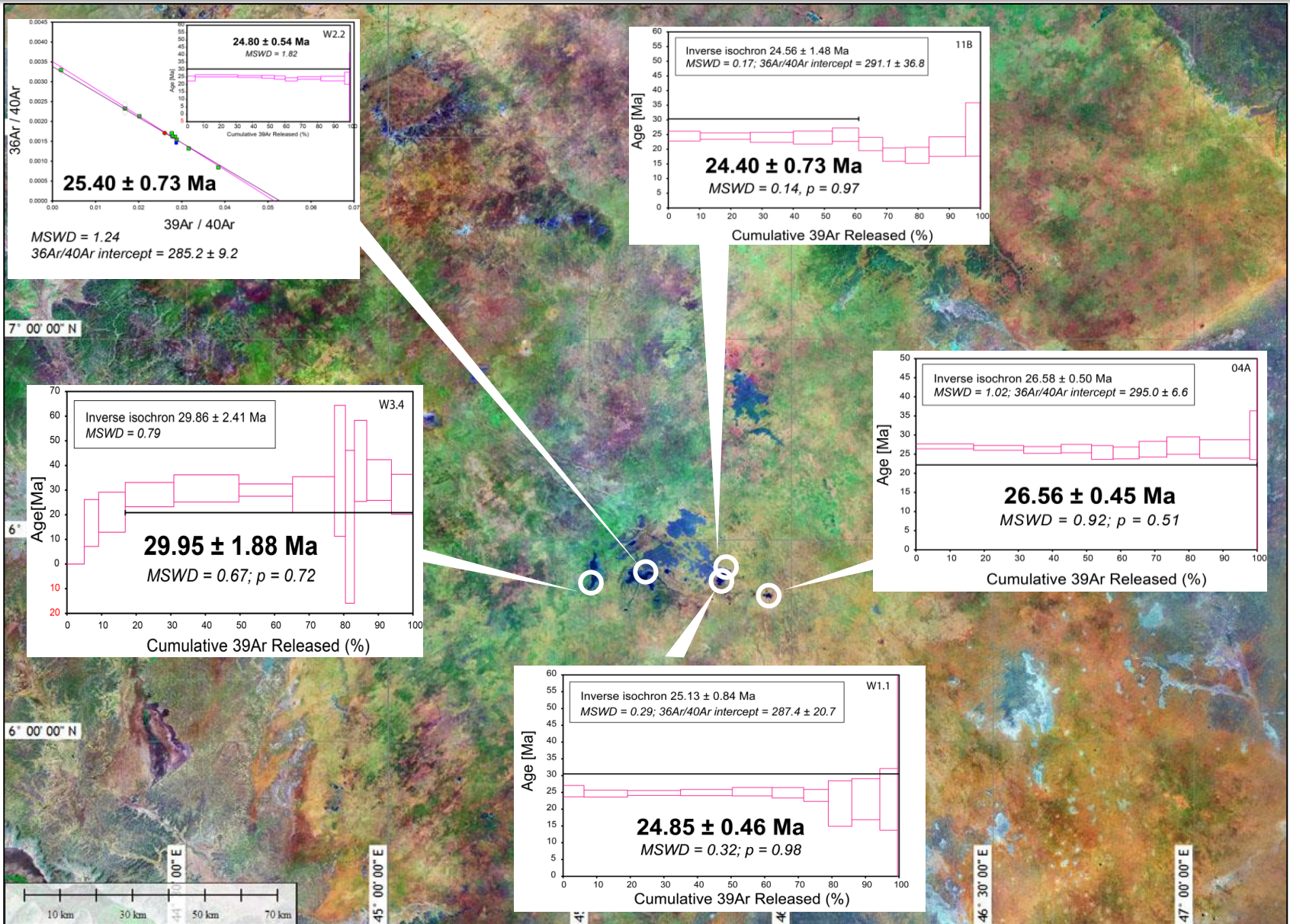


dolerite dyke

Sampling dyke outcrops, eastern Ilbah Hills

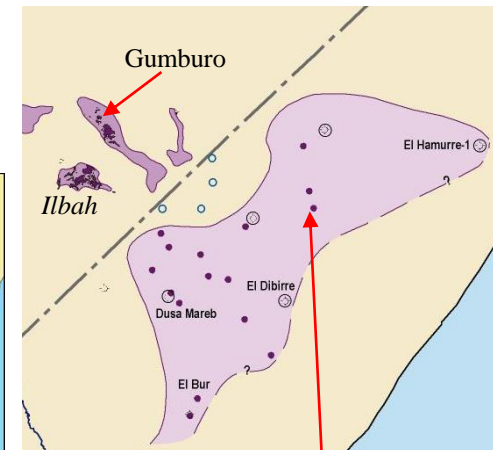
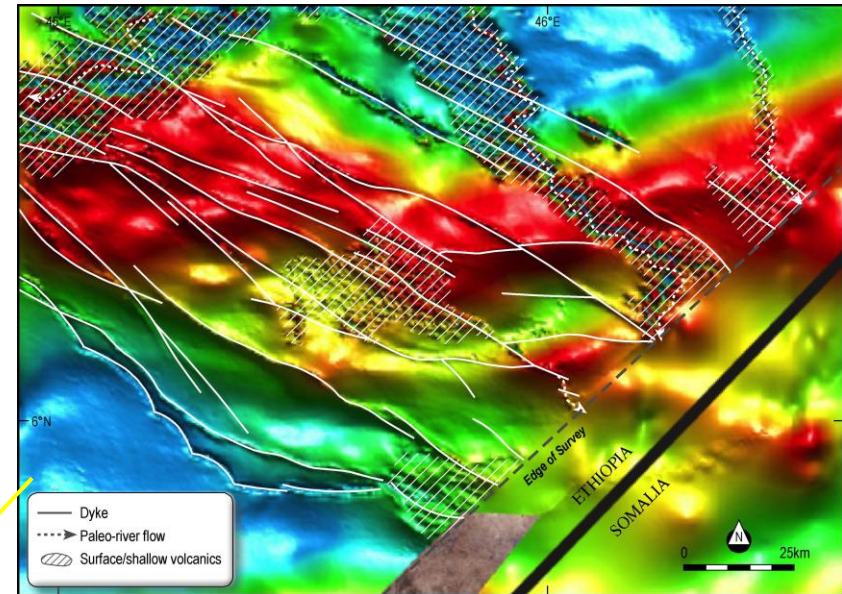
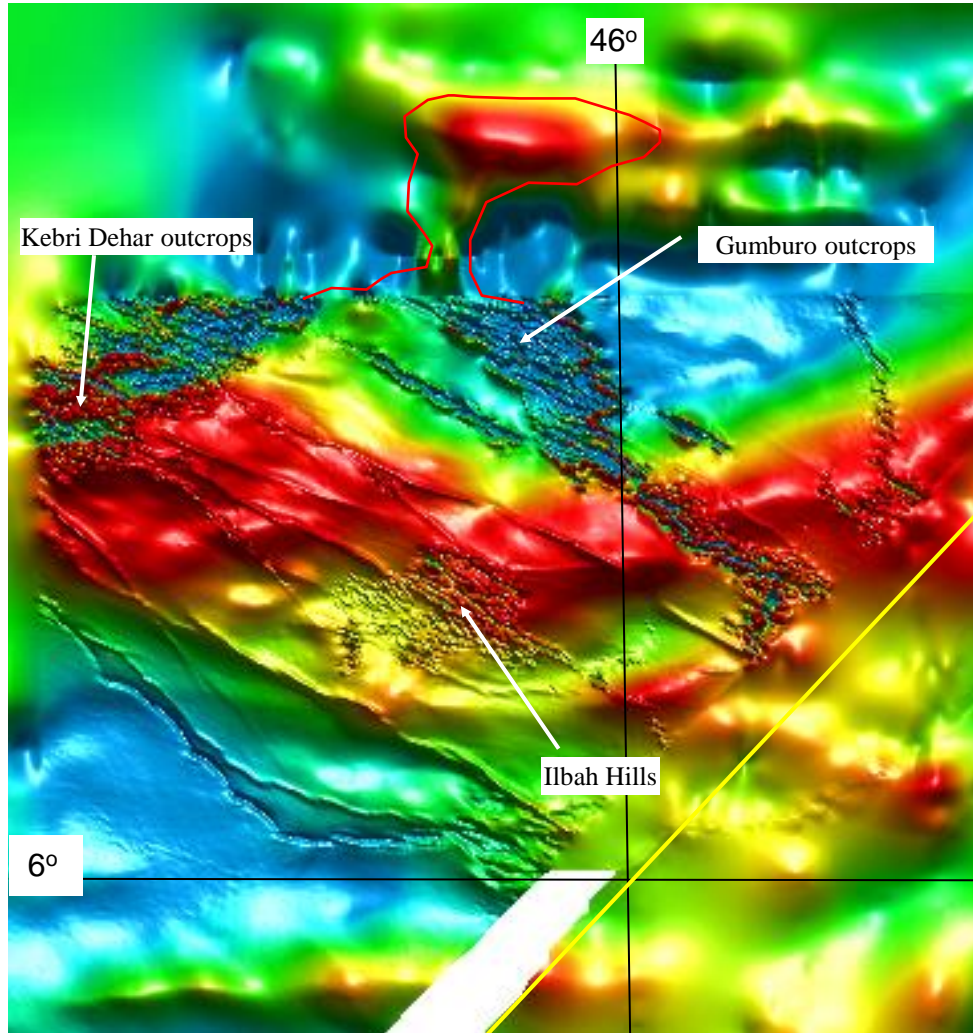
P&R





Magnetic data, Eastern Ogaden

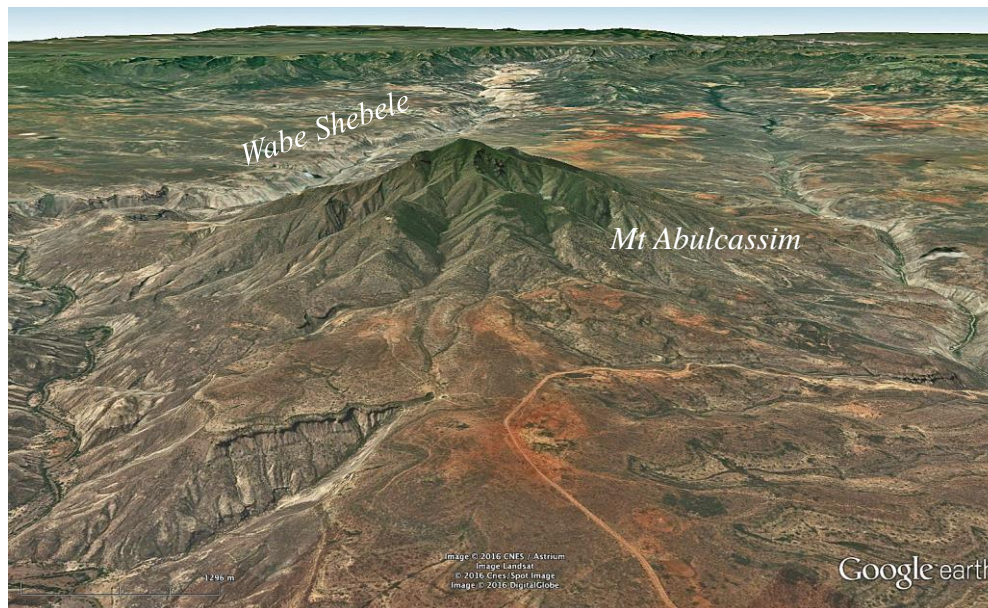
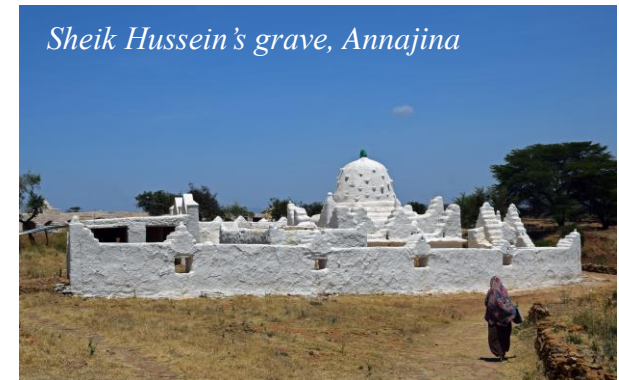
P&R



Oil wells and water bores prove extensive shallow Oligocene 'sill' in Tertiary sequence

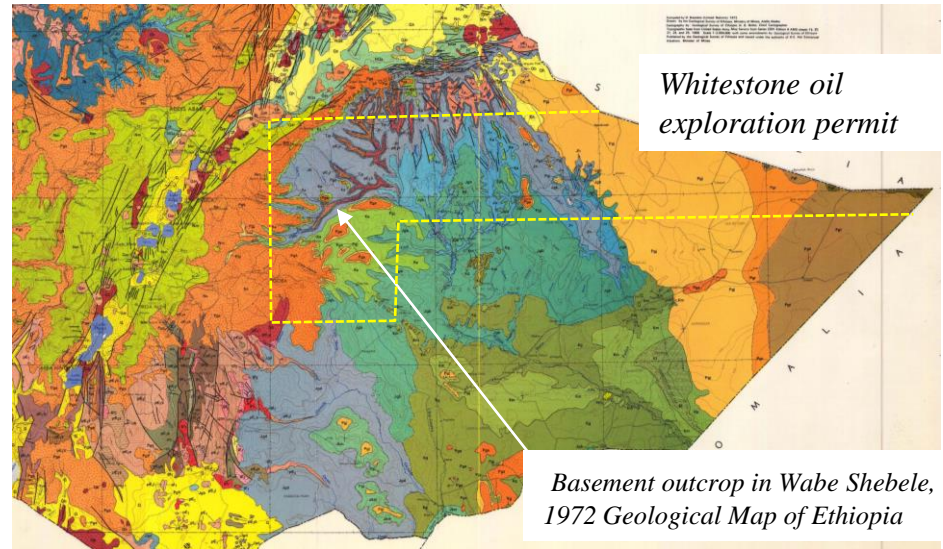
Mt Abulcassim

P&R



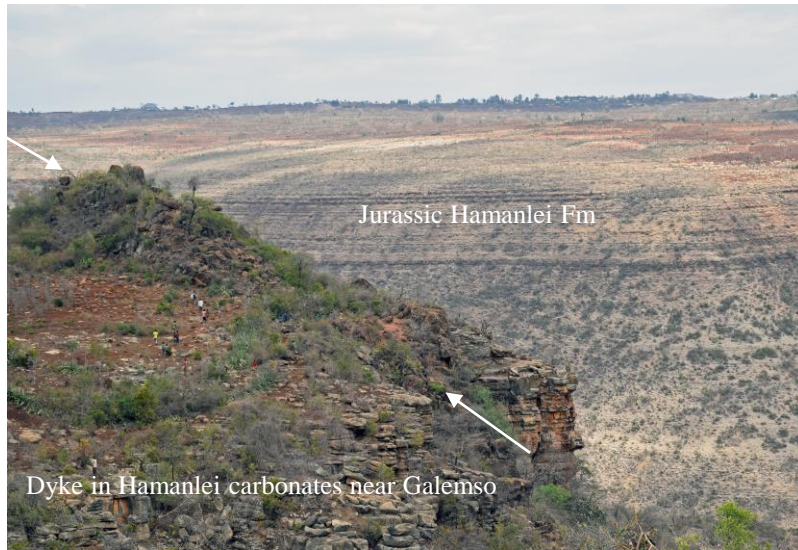


Mapping near Mt Abulcassim, 1976

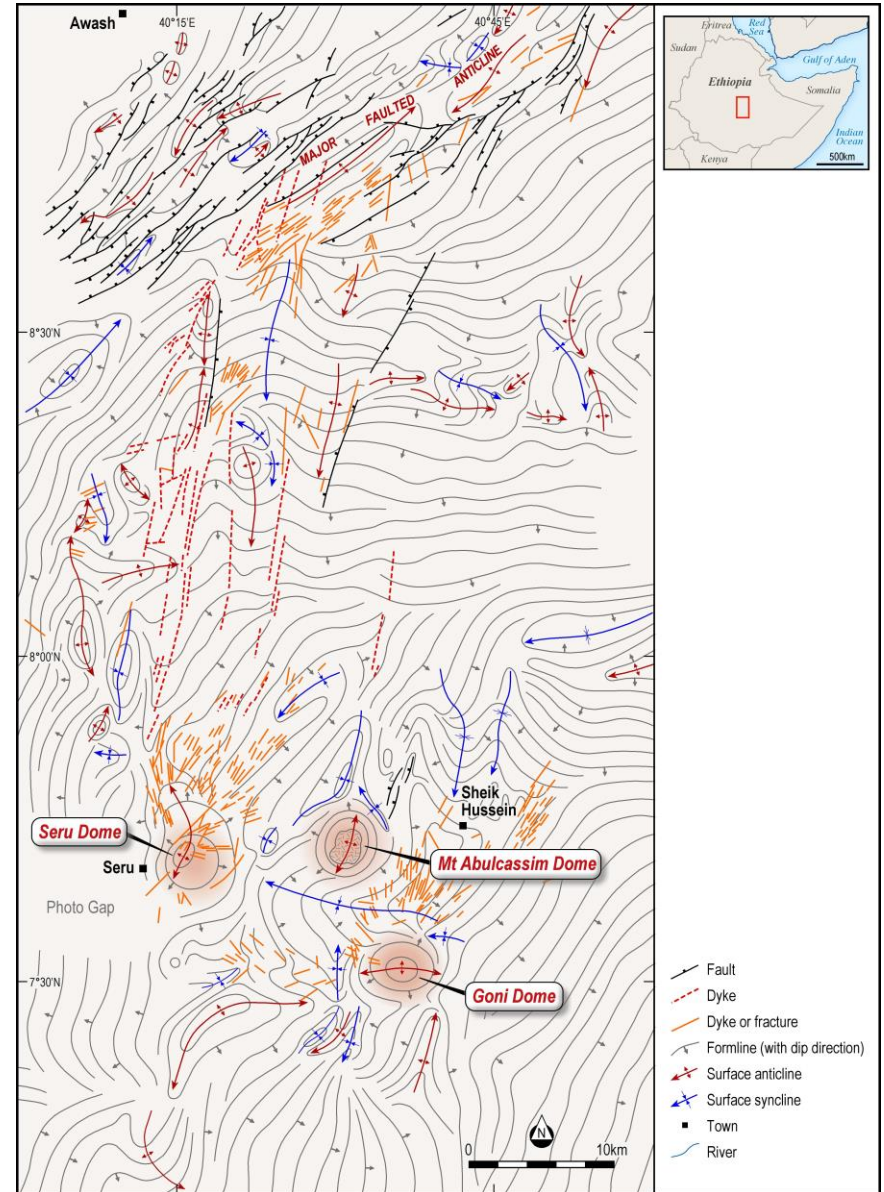


Photogeological map, northwest Somalia Plateau

P&R

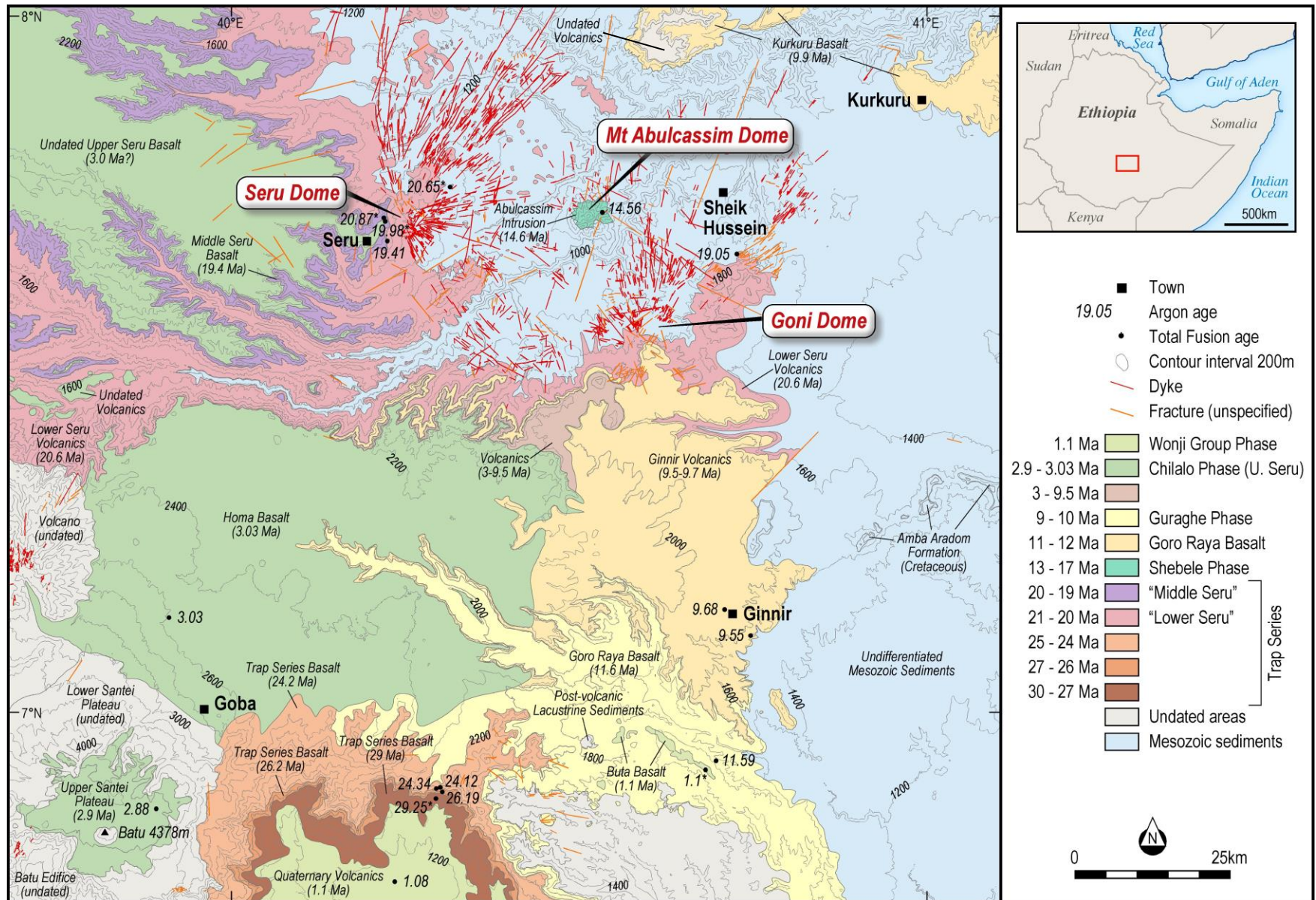


Uplifted Hamanlei Fm (c25° dip) on SE flank of Mt Abulcassim



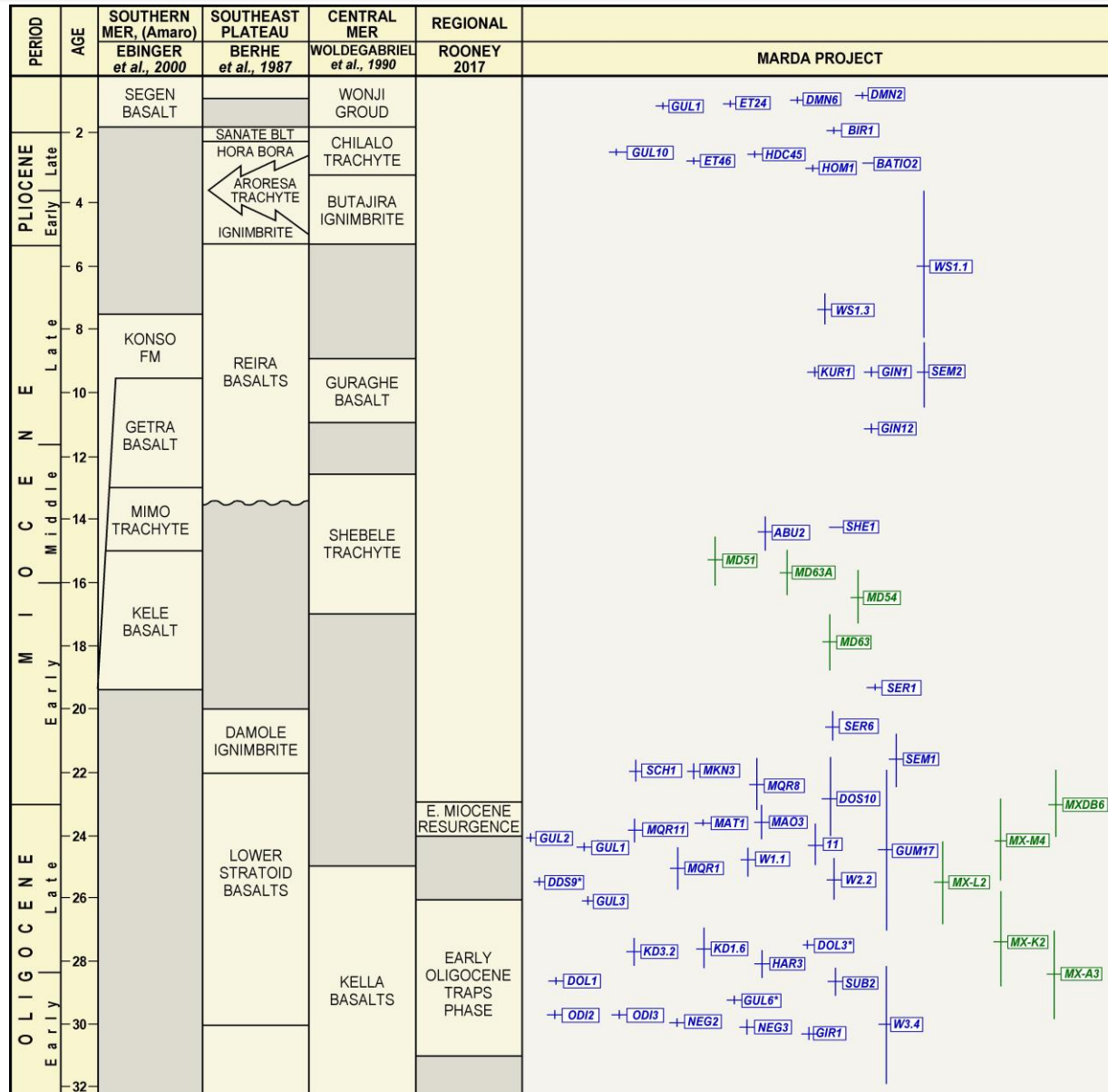
New geological mapping of volcanic areas

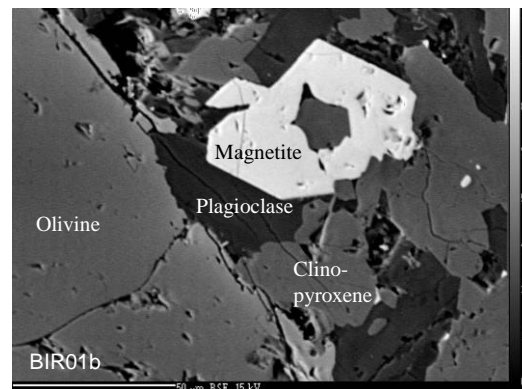
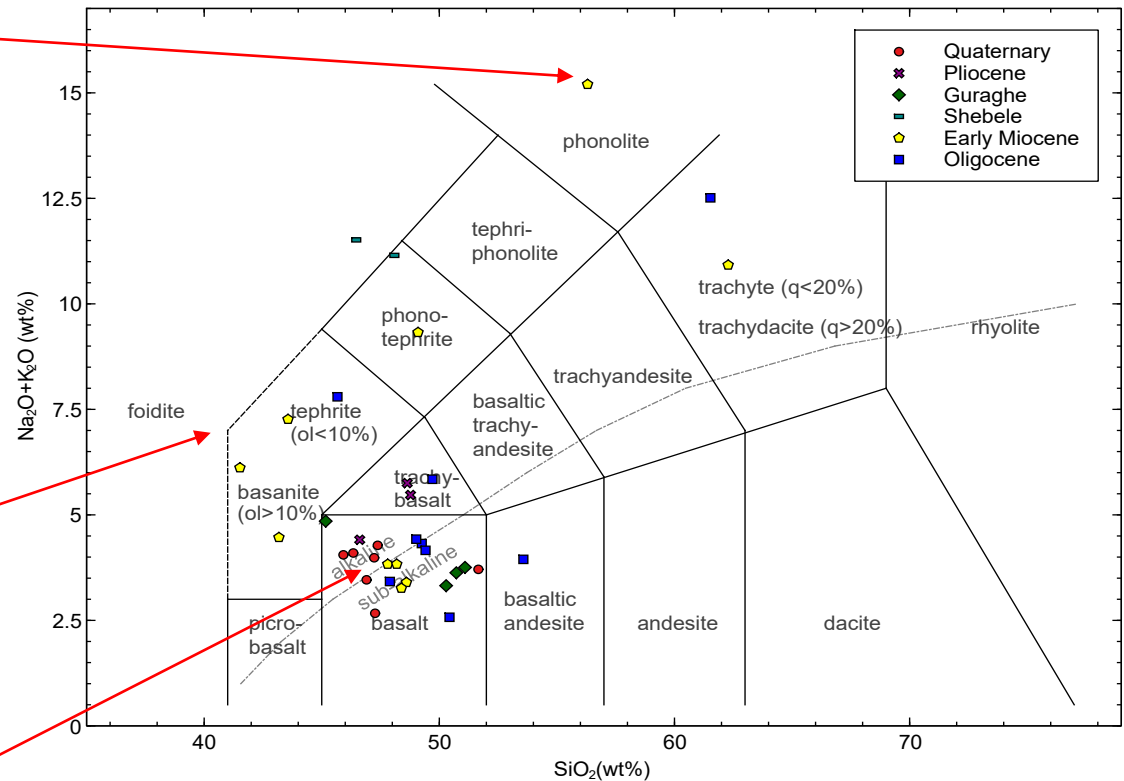
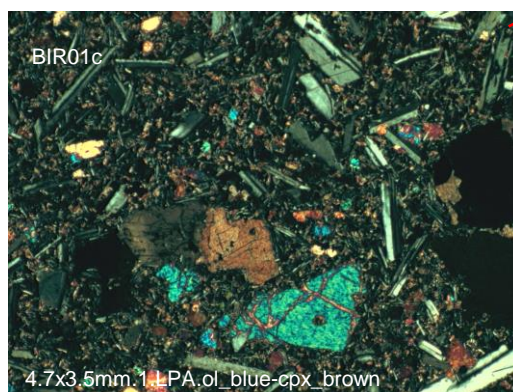
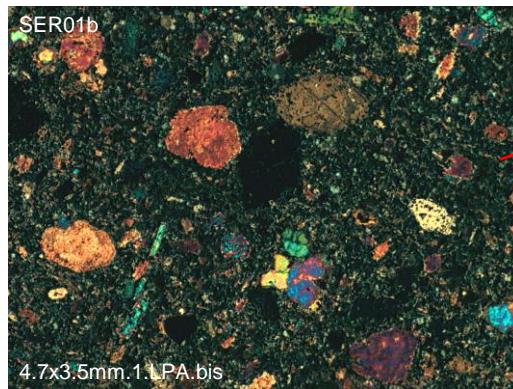
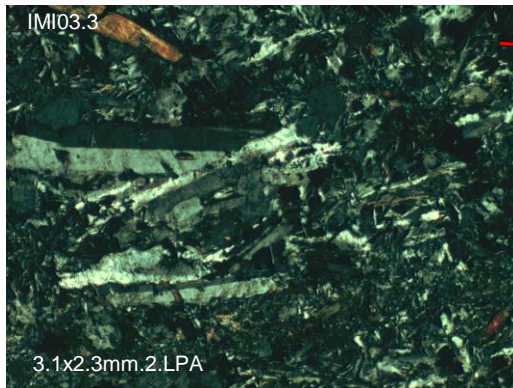
P&R



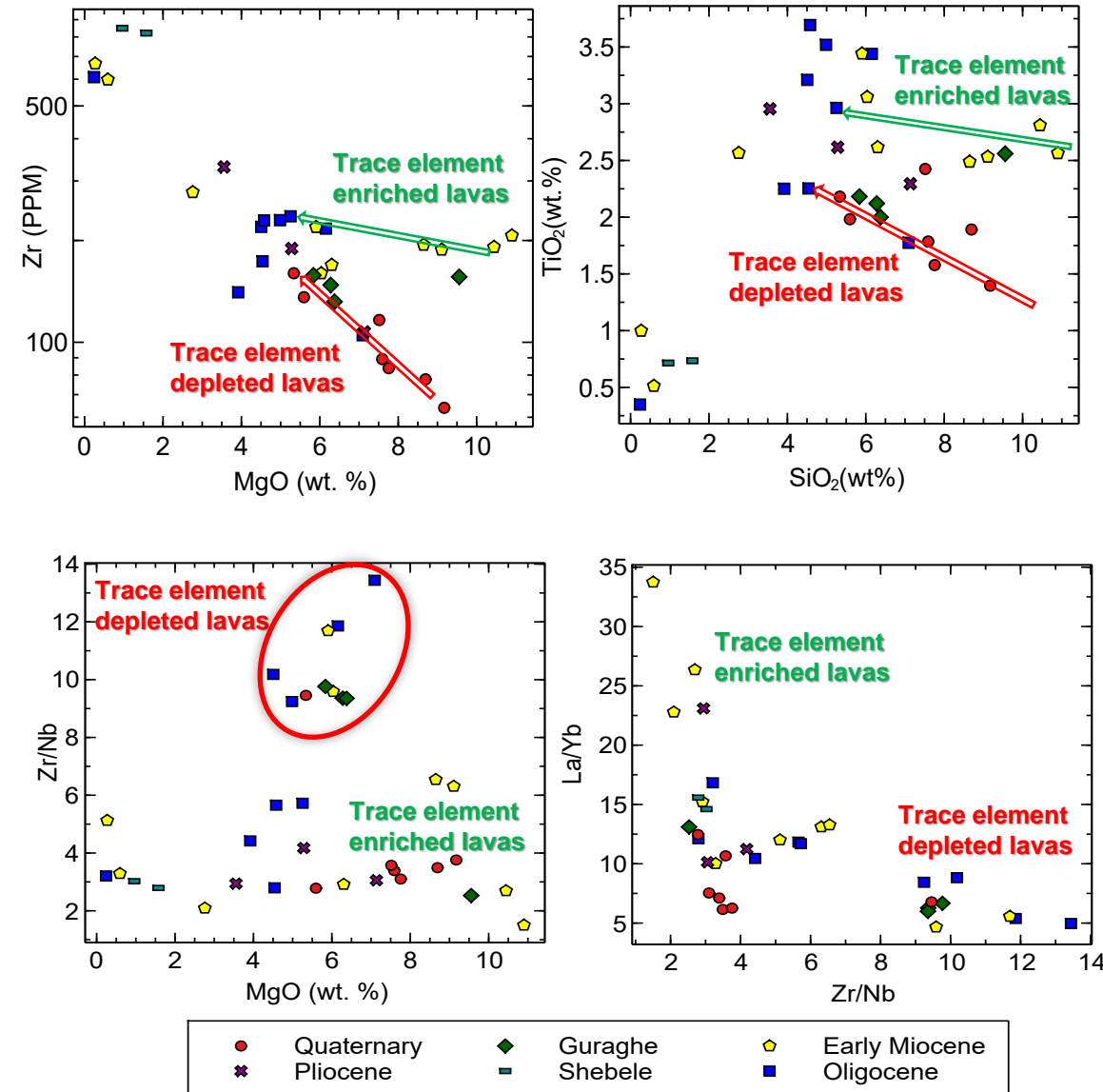
Argon/Argon age-dating of volcanics

P&R





- 2016 data suggest an overall alkaline trend but it is not well controlled
- Approximately 80% of the 2016 samples studied are basalts and trachybasalts
- Single occurrences of foidite, phonolite, trachyte, trachydacite and basaltic andesite were noted.



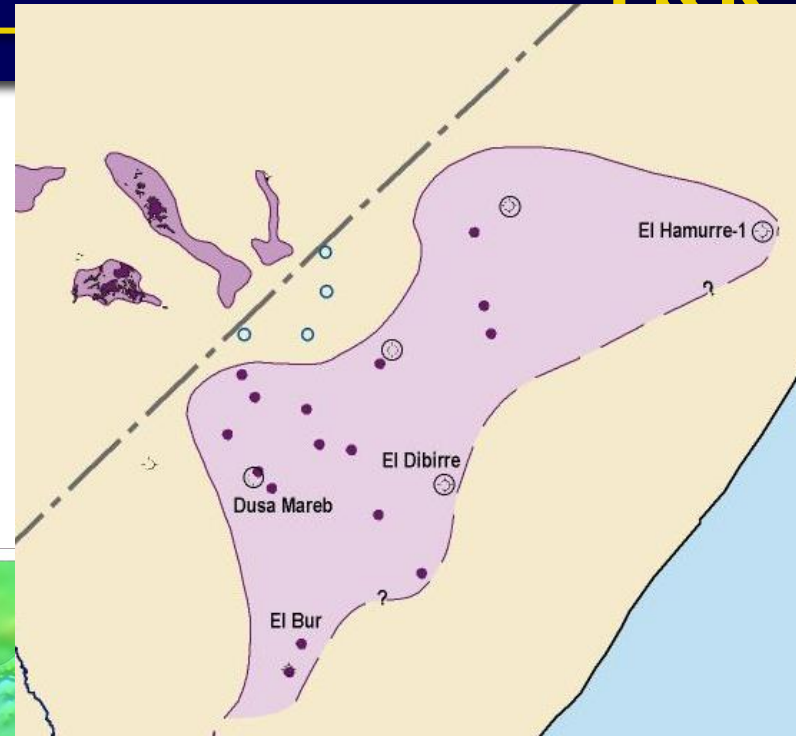
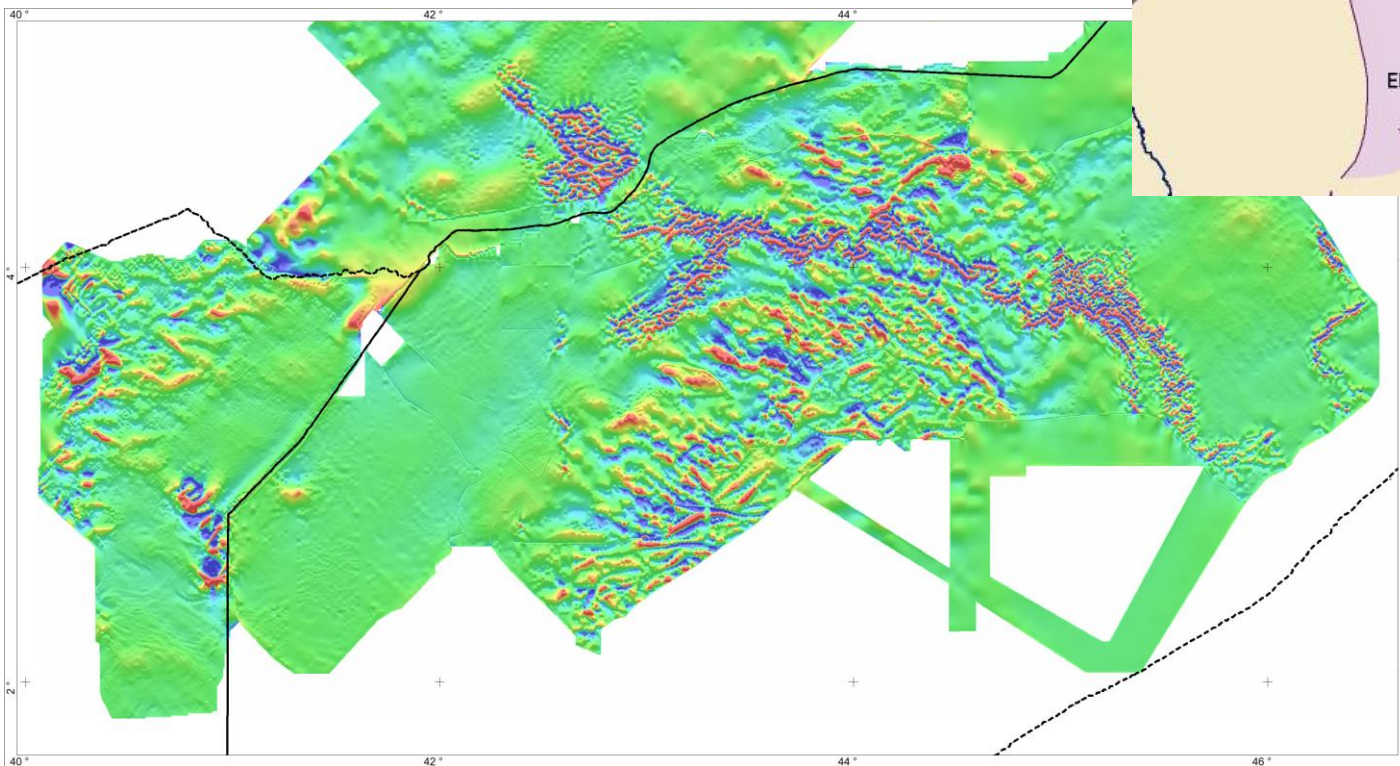
- Magmas exhibit heterogeneity in process but not temporally-based
- Three magma types are indicated:
 - Type II from Early Miocene, high MgO and CaO, extreme TE enrichment, derived from Afar Plume (HT2 style) or mantle metasome (or both)
 - Guraghe lavas, more TE depleted
 - Quaternary moderately depleted lavas
- From a temporal perspective, the following sequence is indicated:
 - Initial (Oligocene-E Miocene) stage has both a depleted magma and a relatively enriched magma, paralleling the significant magmatic heterogeneity on the NW Ethiopian Plateau
 - Shebele period defined by very alkaline lavas, overlapping the E Miocene which suggests some process continuity and synonymous with E African phonolite eruptions
 - Guraghe period of renewed basaltic volcanism, represented by typically depleted lavas
 - Pliocene to Quaternary lavas are similar and moderately depleted relative to Guraghe lavas

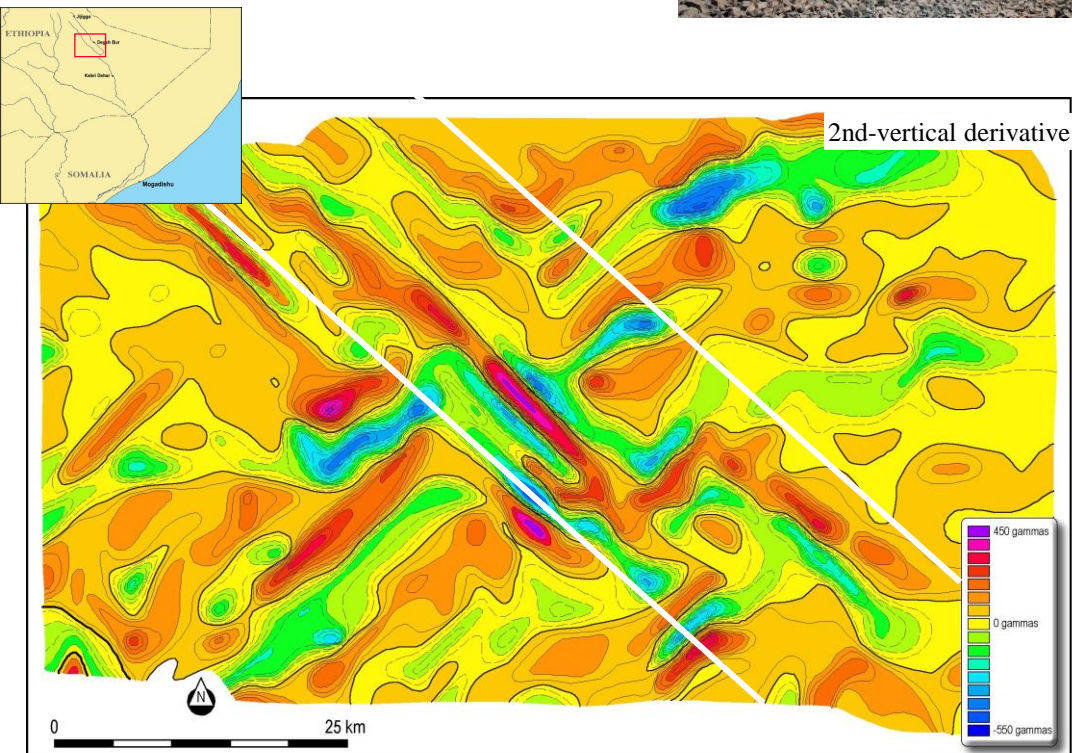




Paleovalley-filling flows and conglomerates

P&R





- The linearity of the outcrop has been interpreted in terms of fissure eruption along the fault zone
- However, a meander-like form at the southern end prompted speculation that the linearity results from lava filling an ancestral Fafan River
- Magnetic data collected during oil exploration in the 1970s shows prominent NW/SE and NE/SW high frequency/amplitude anomalies that appear to be related to shallow dykes.
- Recently completed field work has confirmed a major basalt unit capping the ranges, as well as significant intrusive activity, revealing a complex multi-phase magmatic history

