Today's remarkable understanding of the entire Ethiopian rift system yet leaves unanswered questions. The author, after half-a-century of questing, remains intrigued by some of these:

1. The apparently contrasting structural style of the western Afar margin, to south and north of latitude 13°, in conjunction with a change in thickness of the Oligocene flood-lava pile.
2. The significance of the disconnected chain of Quaternary marginal graben along the western Afar margin.
3. The significance of the active Dubbi-Nabro-Oyma volcanic line, coincidentally on a northerly projection from Ethiopian Rift active volcano-tectonism.
4. Are regular volcano spacings in the African rift system related to lithospheric thickness? If not, what?
5. Is the regional stress pattern suggested by Oligo-Miocene dike orientations in Ethiopia, elucidated in 1971, valid?
6. Does the Galema/Sagatu dike swarm along the eastern shoulder of the northern Ethiopian Rift mark a transient switch of intense extension from out of the rift valley, or a mid-Quaternary boost to continuing axial rifting?
7. Is the Badditu/Amaro horst at the southern end of the Ethiopian Rift another if smaller Ruwenzori?
8. Do the recent episodes of fissuring in the sedimentary floor of the rift valley have any tectonic connexion?
9. Loads of other questions.

Eheu Fugaces !
(only time for two ‘rush-job’ summaries)

A. Some Structural and Magmatic features of the Western Afar Margin.

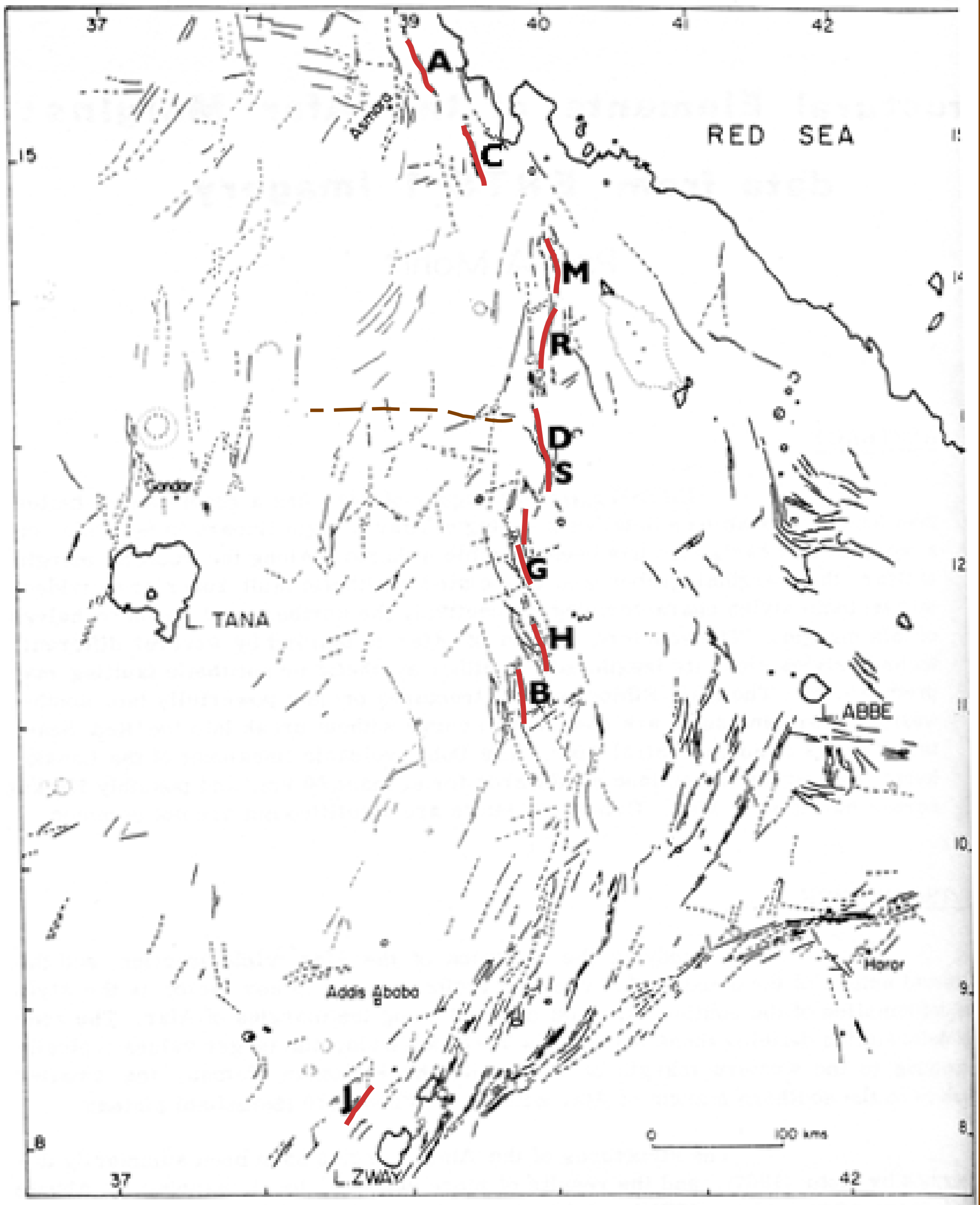
B. The Galema/Sagatu Ridge dike swarm, close along the eastern shoulder of the Ethiopian Rift.

A. Some Structural and Magmatic features of the Western Afar Margin

A1. Structural switch of margin faulting at latitude 13ºN, coinciding with northern edge of thick flood-basalt pile.

A2. Marginal graben within the western Afar margin: extent, structure, age and cause.

A3. Regional pattern of Ethiopian Tertiary dike swarms:
(a) regional curvature of dike trend;
(b) interconnected dip directions of dikes of all trends in a given region.



Ailet

Comayli

Maglala

Renda Coma

Dergaha-Sheket

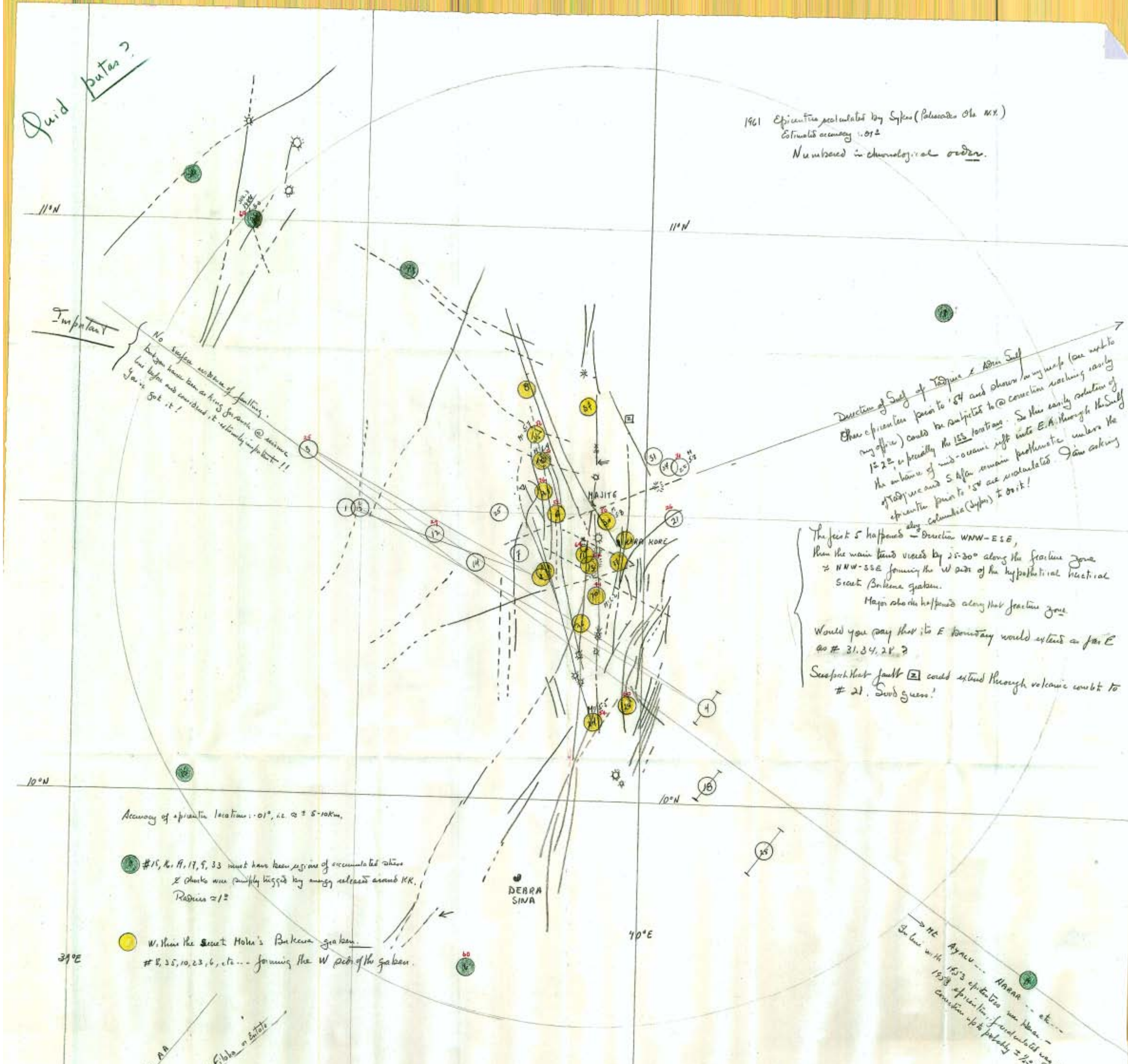
Guf Guf / Azebu-Kobo

Menebay-Hayk

Borkenna-Robi

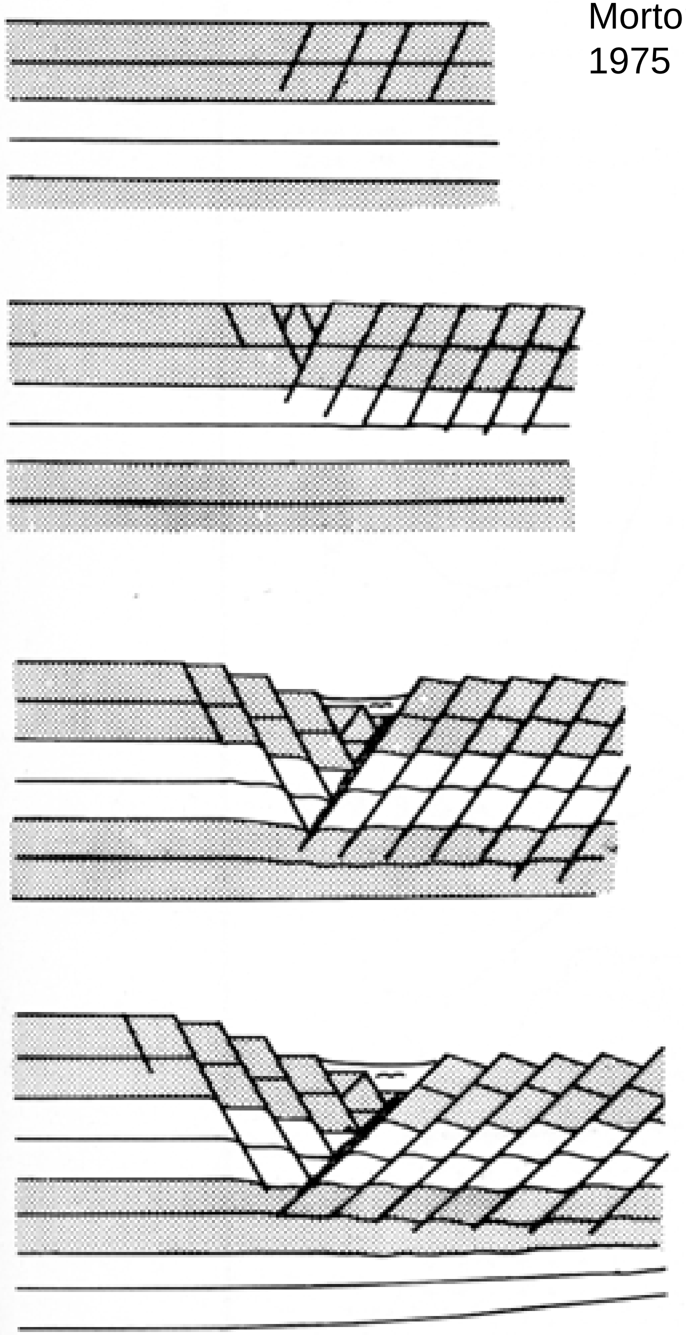
Butajira

[BGOAA 1975]



Quid putas?
Important
No surface evidence of faulting.
Got it!
11°N
11°N
MAJITE
KARA KORE
DEBRA
SINA
10°N
10°N
39°E
40°E
1961 Epicentres recalculated by Sykes (Palisades Obs. N.Y.)
Estimated accuracy ±.01°
Numbered in chronological order.
The first 5 happened along direction WNW-ESE,
then the main trend veered by 25-30° along the fracture zone
≈ NNW-SSE forming the W side of the hypothetical tectonical Secret Borkena graben.
Major shocks happened along that fracture zone
Would you say that its E boundary would extend as far E as # 31, 34, 28 ?
Suspect that fault [z] could extend through volcanic conduits to # 21. Good guess!
Accuracy of epicentre locations: ·01°, i.e. ≈ ± 5-10Km.
#15, 16, 19, 17, 9, 33 must have been regions of accumulated stress & shocks were possibly triggered by energy released around KK. Radius ≈ 1°
Within the Secret Mohr's Borkena graben.
#8, 35, 10, 23, 6, etc... forming the W side of the graben.
Mt AYALU ... HARAR ... etc...

Morton & Black, 1975



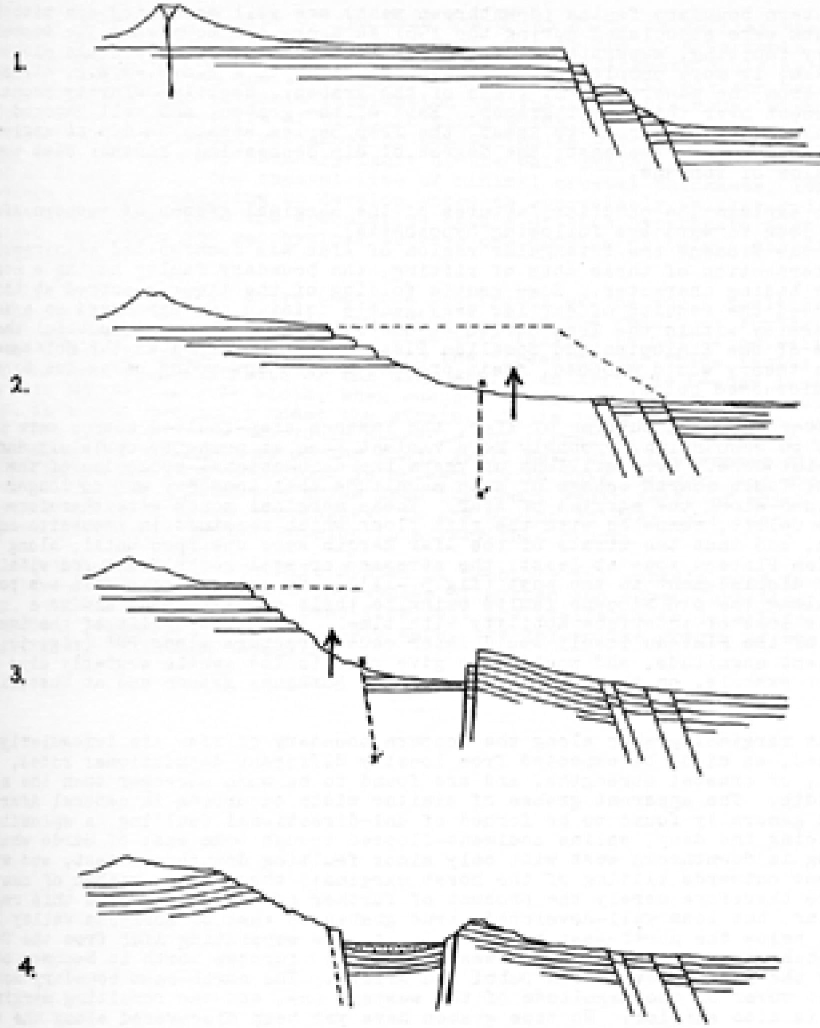


Fig. 5. Stages in the development of the Borkenna graben.

1. Main Miocene post-Trappean rifting
2. Denudation proceeds and isostatic crustal strain develops
3. Isostatic readjustment causes fracturing along AA' (exampled in the present-day Guf Guf valley.)
4. Further readjustment causes fracturing along BB' (exampled in the present-day Borkenna valley.)

(vertical scale greatly exaggerated)

Mohr, 1962

A3. Ethiopian Tertiary dike swarms

A valid regional stress-pattern interpretation?

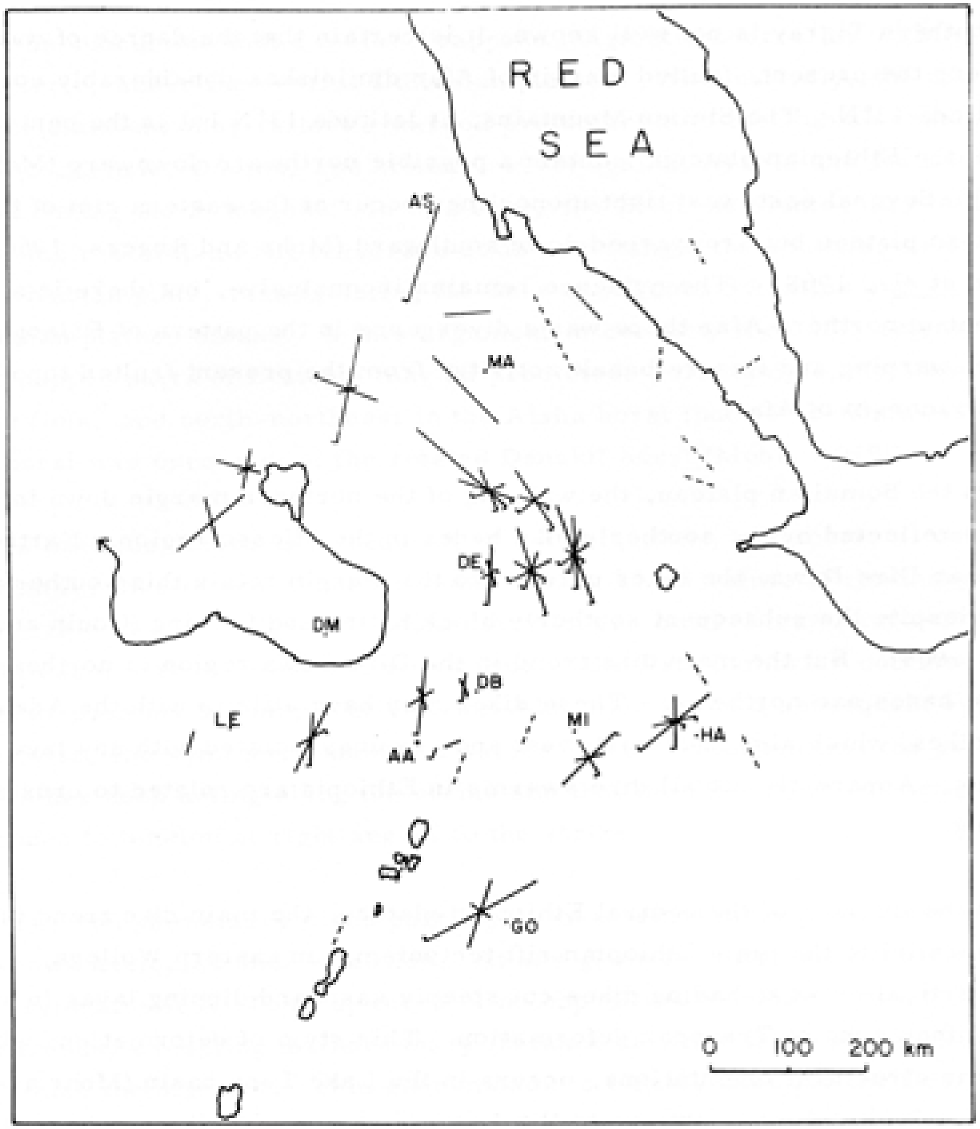
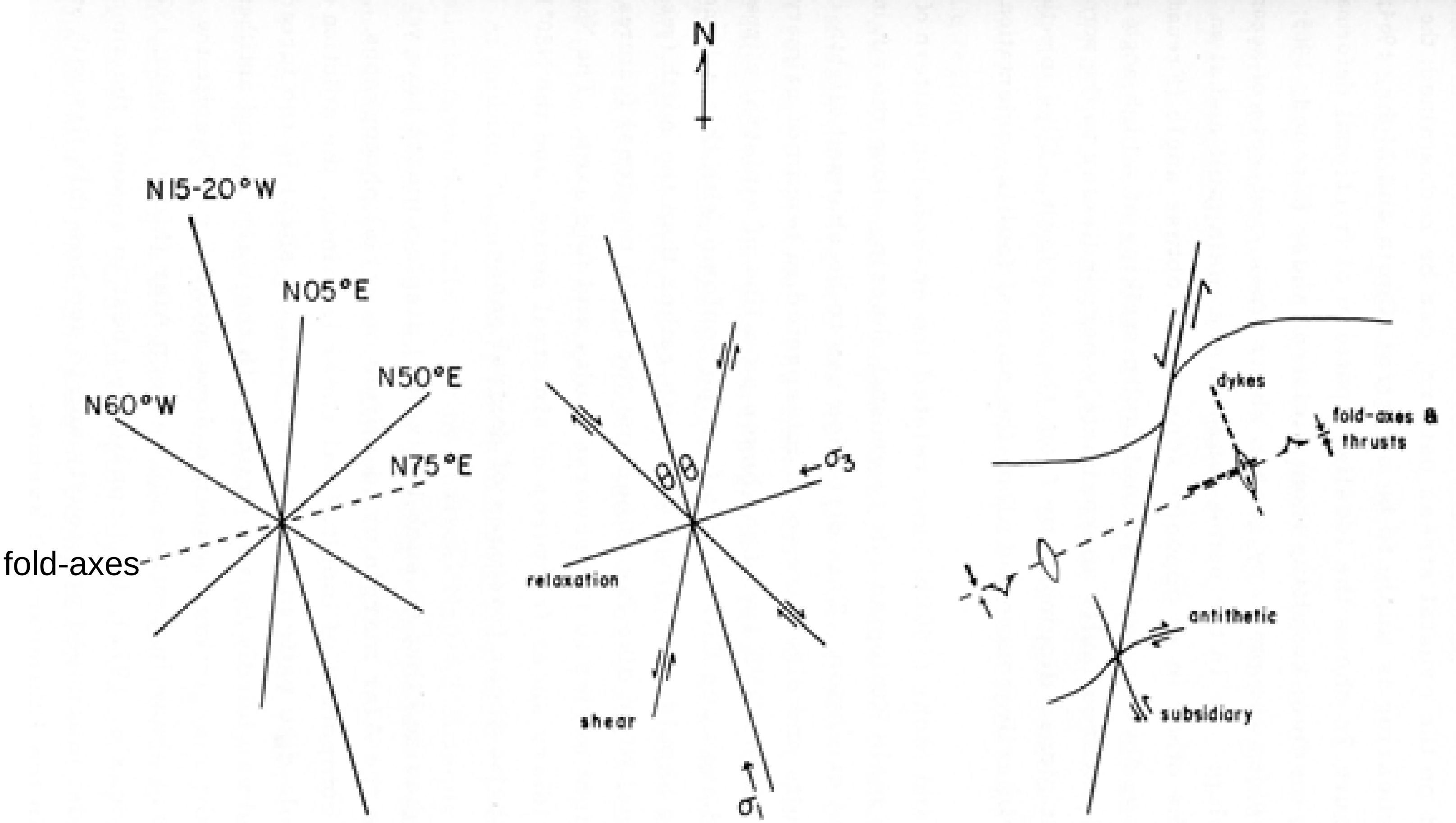


Figure 8. Schematic representation of regional dike trends and hade directions in Ethiopia (where known). Length of lines indicates relative abundances of intersecting trends for the particular locality. Dotted lines indicate Quaternary fissure basalt lines. (AA: Addis Ababa; AS: Asmara; DB: Debra Berhan; DE: Dessie; DM: Debra Markos; GO: Goba; HA: Harar; LE: Lekemti; MA: Makalle; Mi: Miesso.)

2-D stress field interpretations, from Dese-Eloa margin dikes



Observed dike trends

Riedel shears

Sinistral shear model

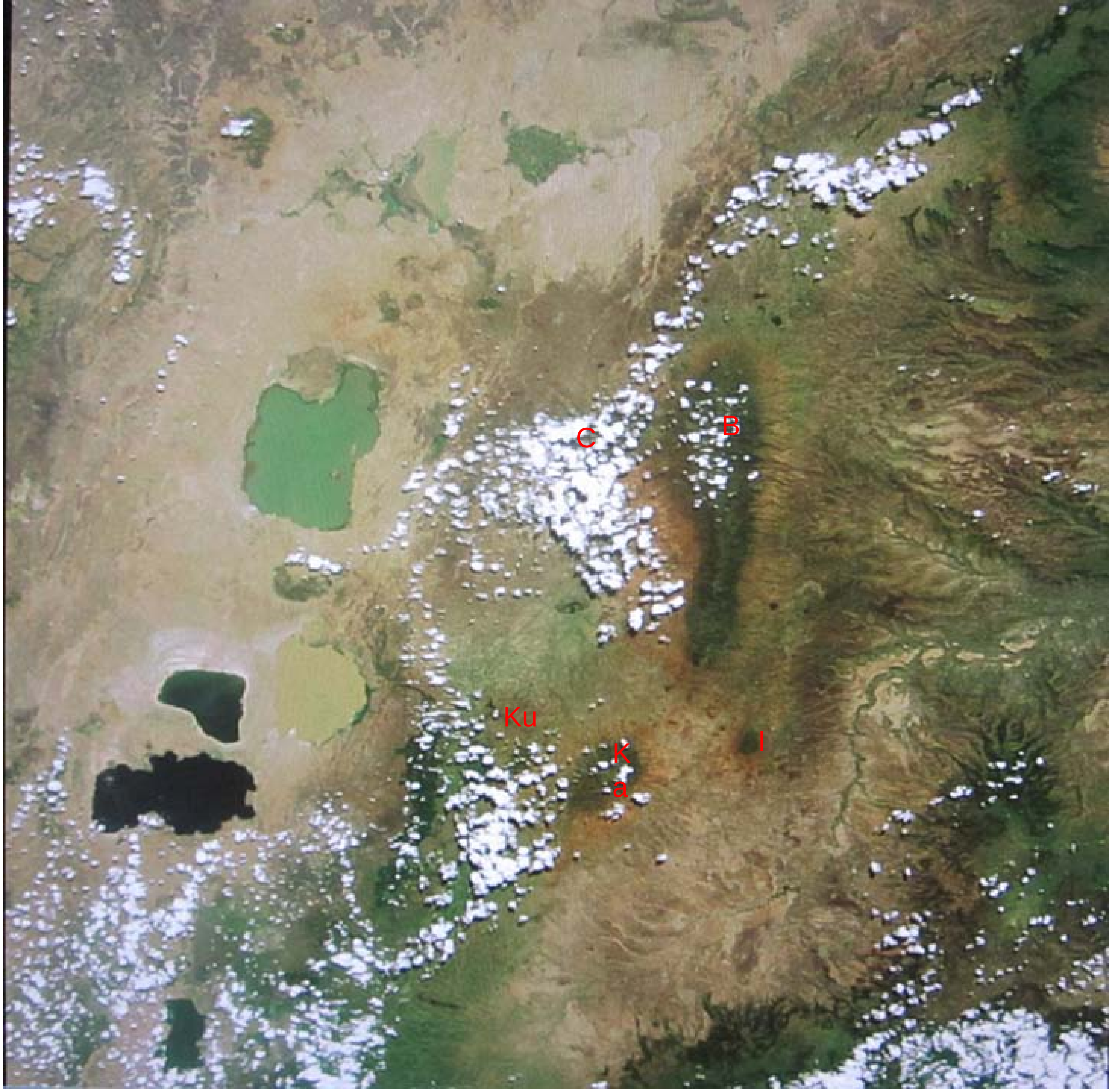
B. Galema/Sagatu mid-Quaternary dike swarm

An extra boost to ?

or . . .

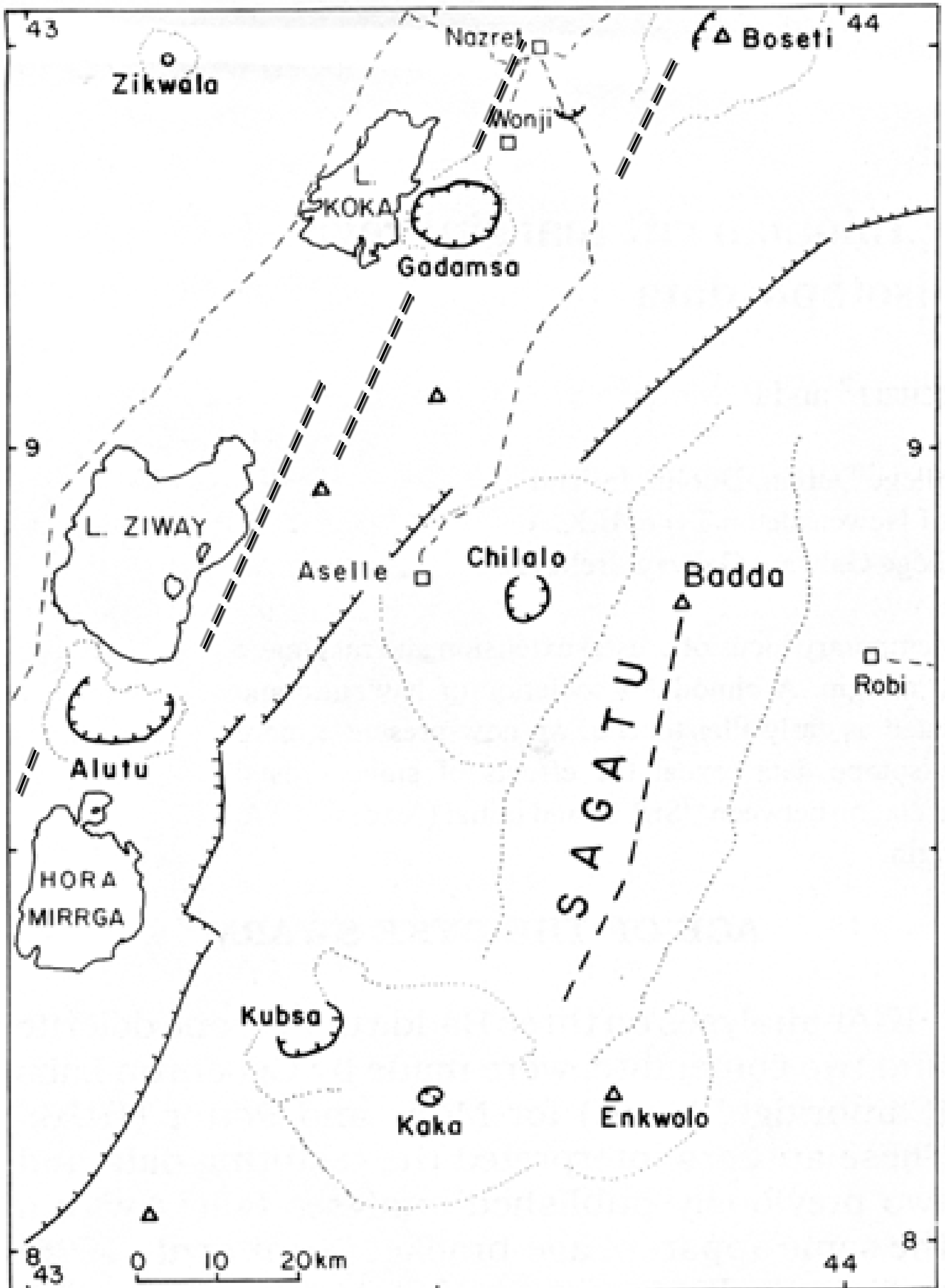
a transient switch from ?

Ethiopian rift valley extension

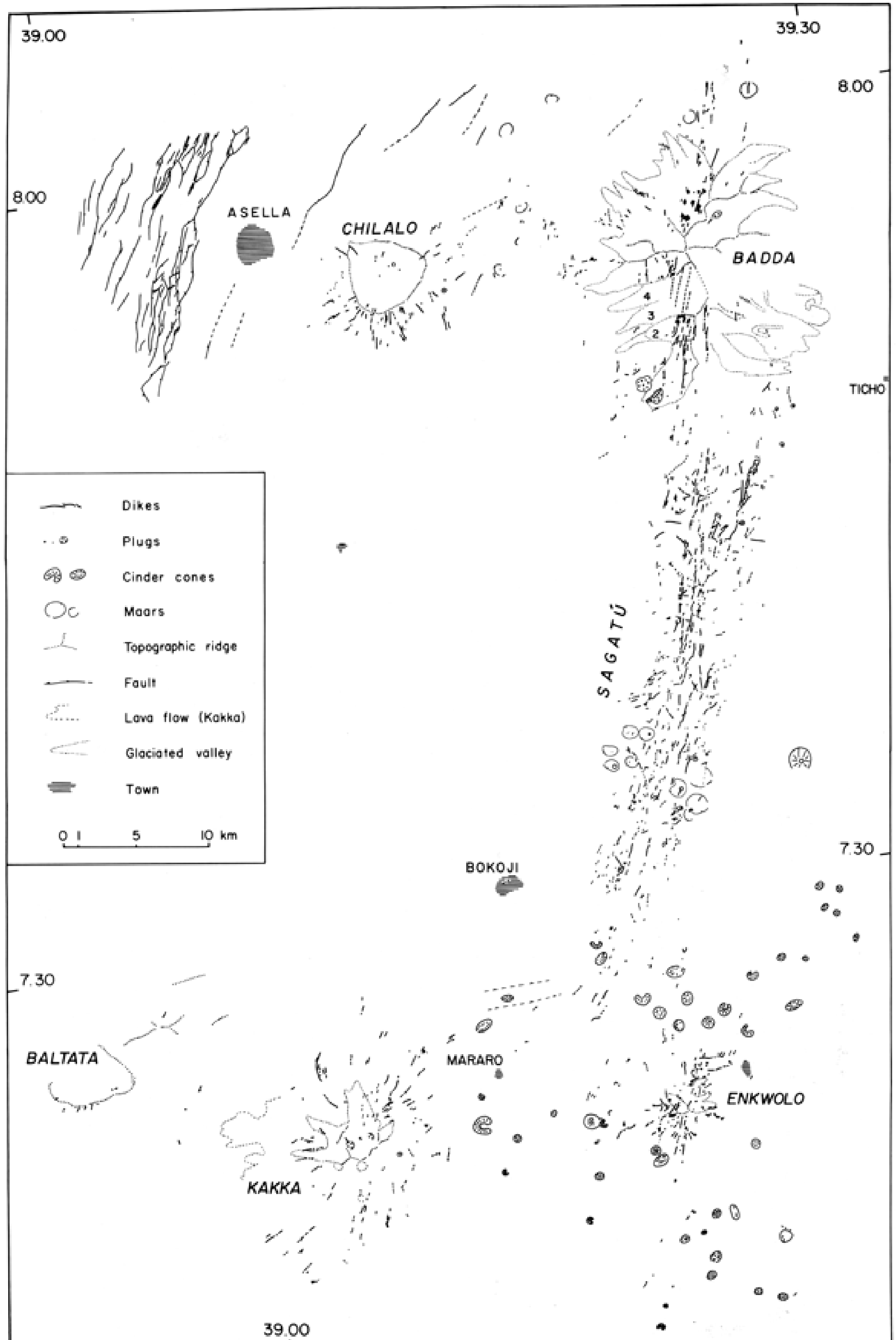


B. Badda
C. Chilalo
I. Inkwolo
Ka. Kaka
Ku. Kubsa

view down valley ‘2’ on W slope of Gara Badda,
looking west to Gara Chilalo.



43
44
Zikwala
Nazret
Boseti
Wonji
L.
KOKA
Gadamsa
9
9
L. ZIWAY
Aselle
Chilalo
Badda
Robi
SAGATU
Alutu
HORA
MIRRGA
Kubsa
Kaka
Enkwolo
8
8
43
44
0
10
20km



39.00
39.30
8.00
8.00
ASELLA
CHILALO
BADDA
4
3
2
TICHO
Dikes
Plugs
Cinder cones
Maars
Topographic ridge
Fault
Lava flow (Kakka)
Glaciated valley
Town
0 1 5 10 km
SAGATU
7.30
BOKOJI
7.30
BALTATA
MARARO
ENKWOLO
KAKKA
39.00

Gara Badda -

dike swarm exposed on the ‘2-3 valley’ divide

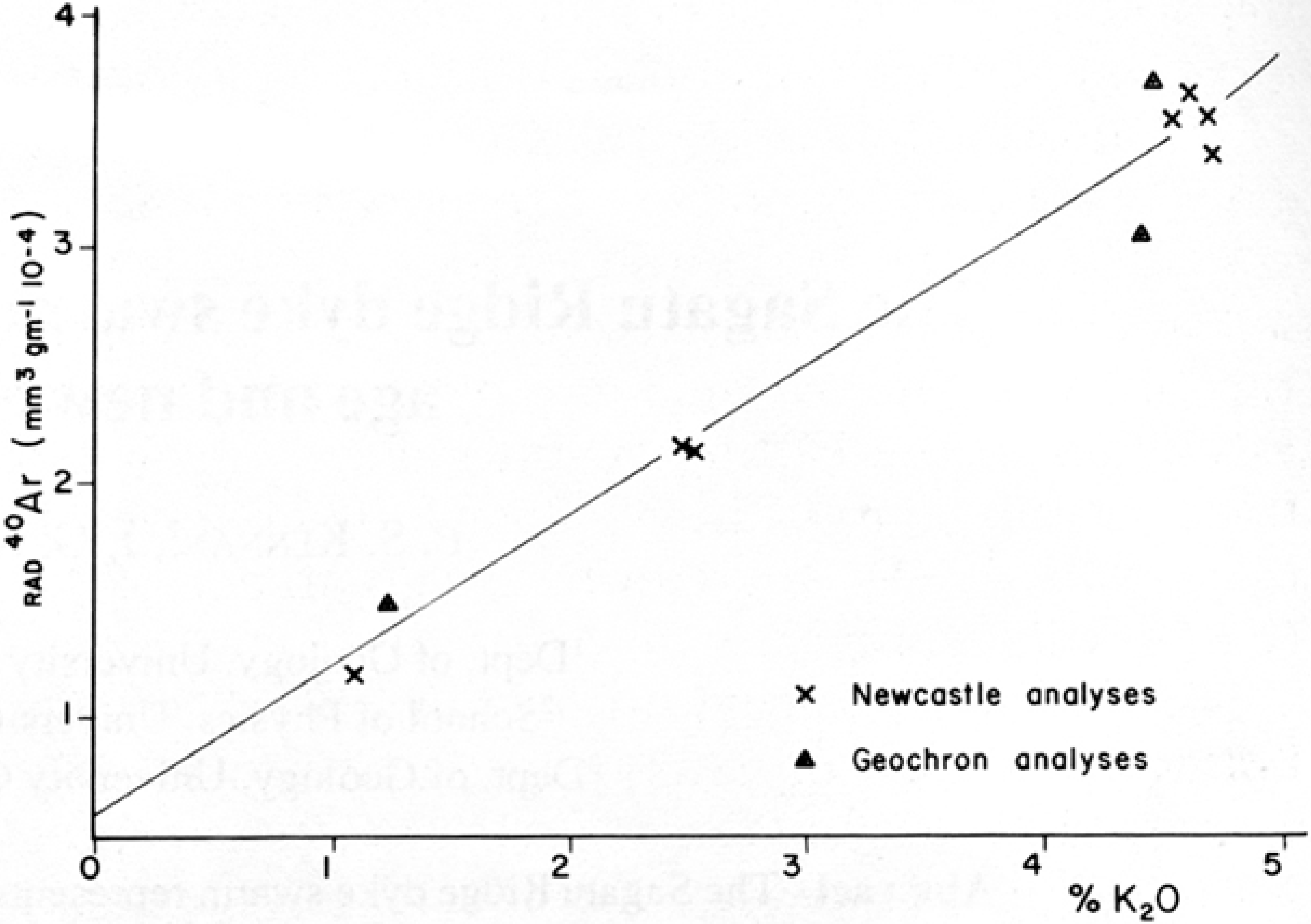
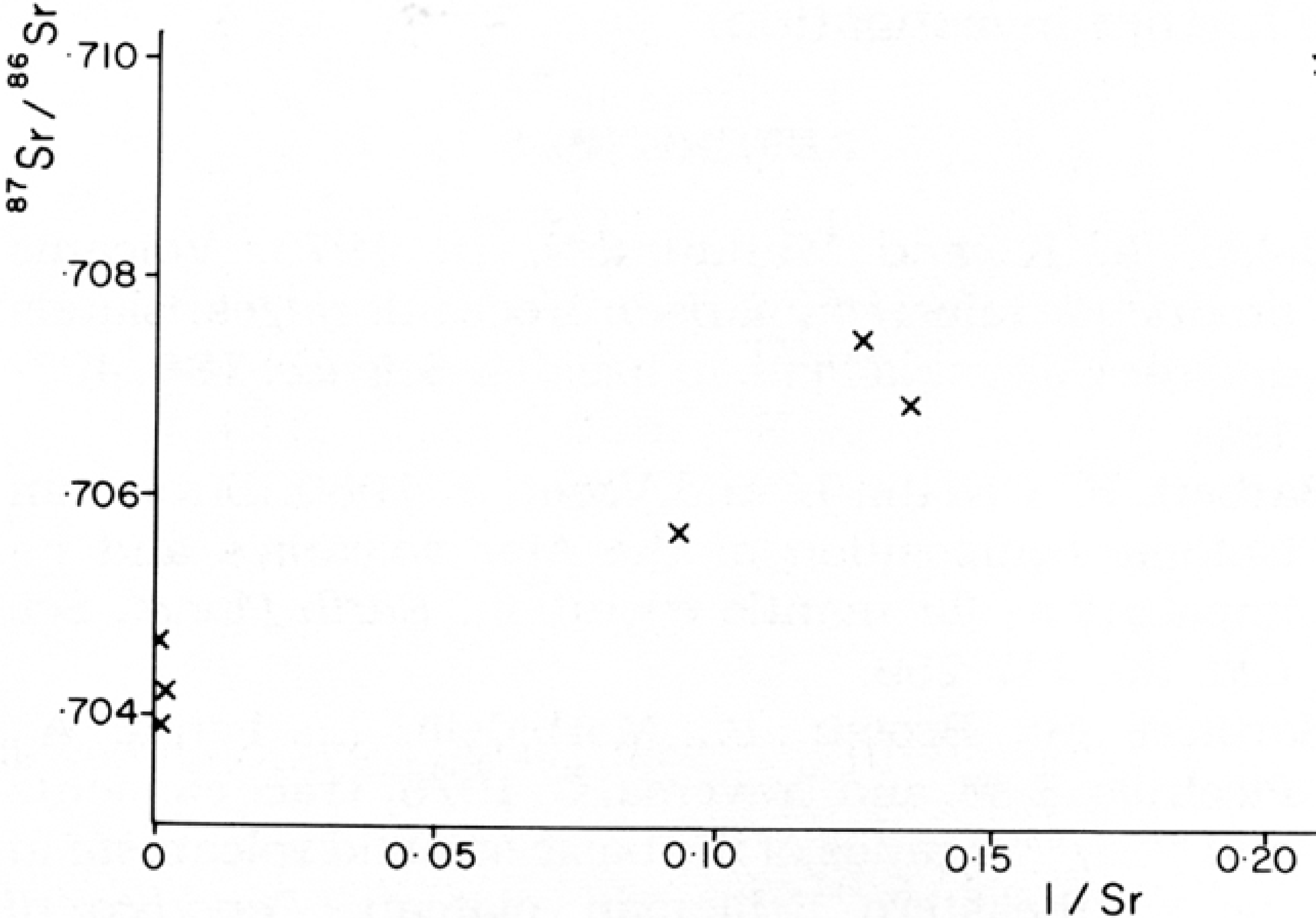


Fig. 2. Isochron plot of radiogenic ^{40}Ar versus percentage potash in the analysed wholerock dyke samples. The slope of the best-fit line corresponds to an age of 1.97 ± 0.02 M.a.

Sagatu hawaiite and comendite dikes



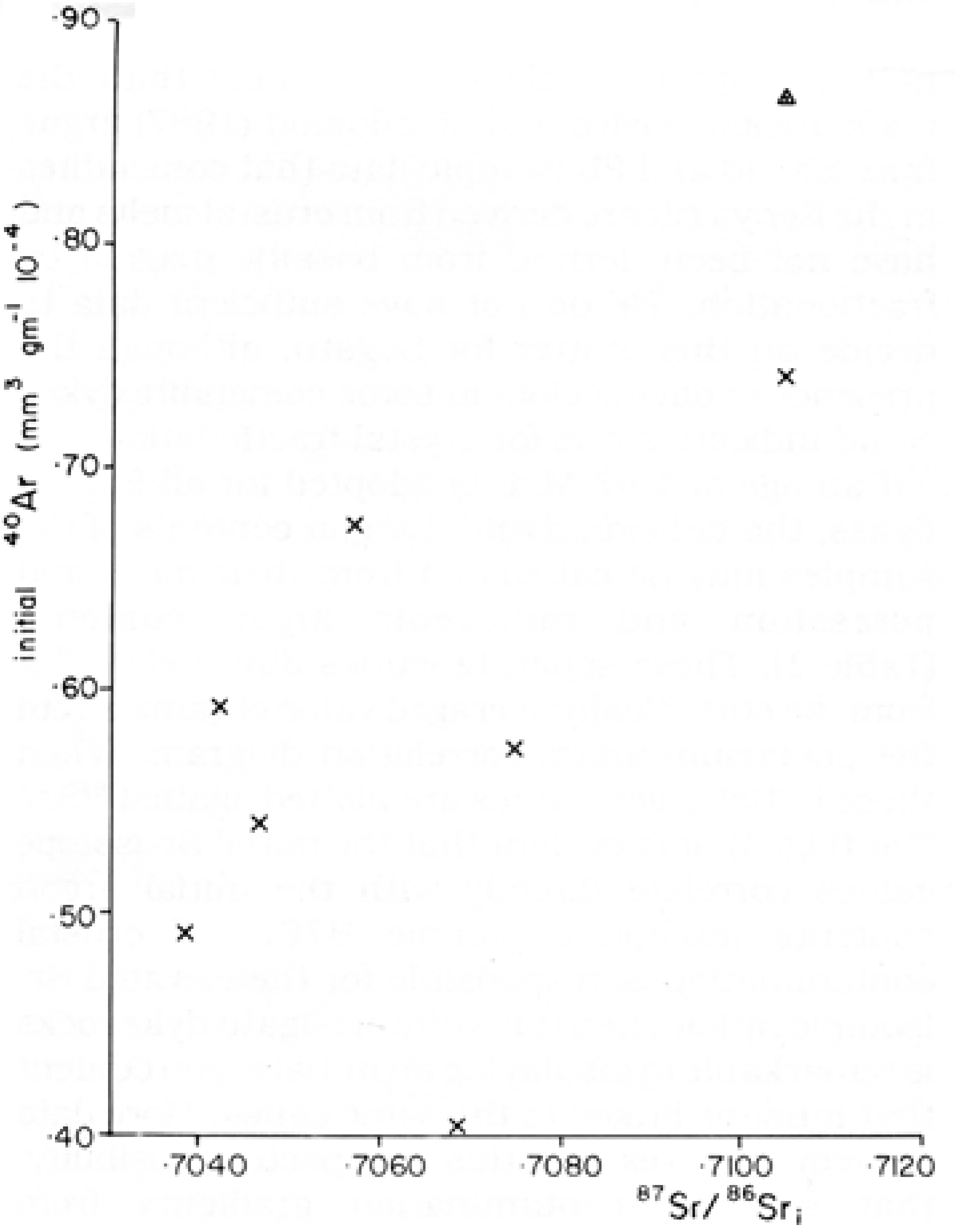


Fig. 4 Plot of initial ("excess") ^{40}Ar v. initial $^{87}Sr/^{86}Sr$ in Sagatu dykes (Tables 1 and 2). Symbols as on Fig. 2. The aberrant point at the bottom of the graph is for comendite B767; the relatively low excess ^{40}Ar content in this dyke is not explained.

Ityopya,

Amersegenalehu !