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Thank you.



# Maps and imagery in boundary demarcation & maintenance



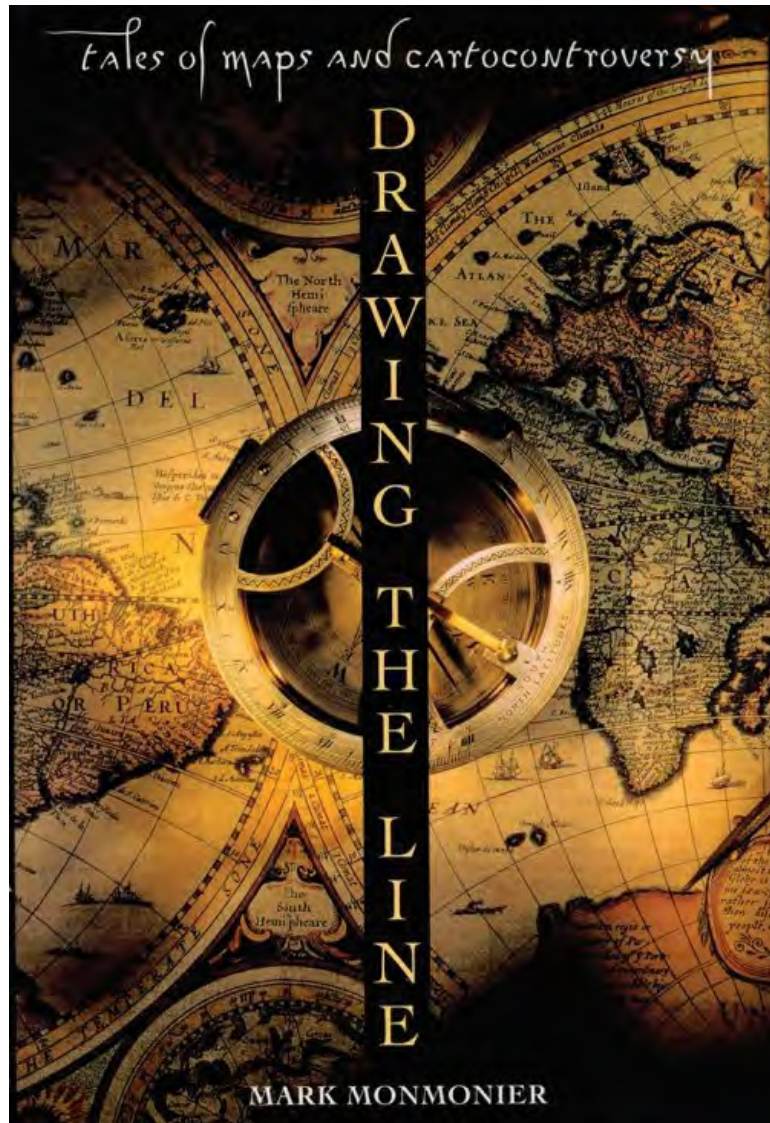
Martin Pratt

**bordermap** consulting

Geographical intelligence for international  
boundary-making and dispute resolution

## **The importance of geographic expertise in boundary-making and border management**

- Good boundaries require an understanding of / sensitivity to both the physical and human landscape of the border area.
- Boundary delimitation and demarcation require technical skills relating to positioning and mapping.
- Effective boundary management requires the organisation (and ideally the exchange) of a wide range of spatial data.
- Boundary dispute resolution invariably involves the analysis and interpretation of complex geographic information.

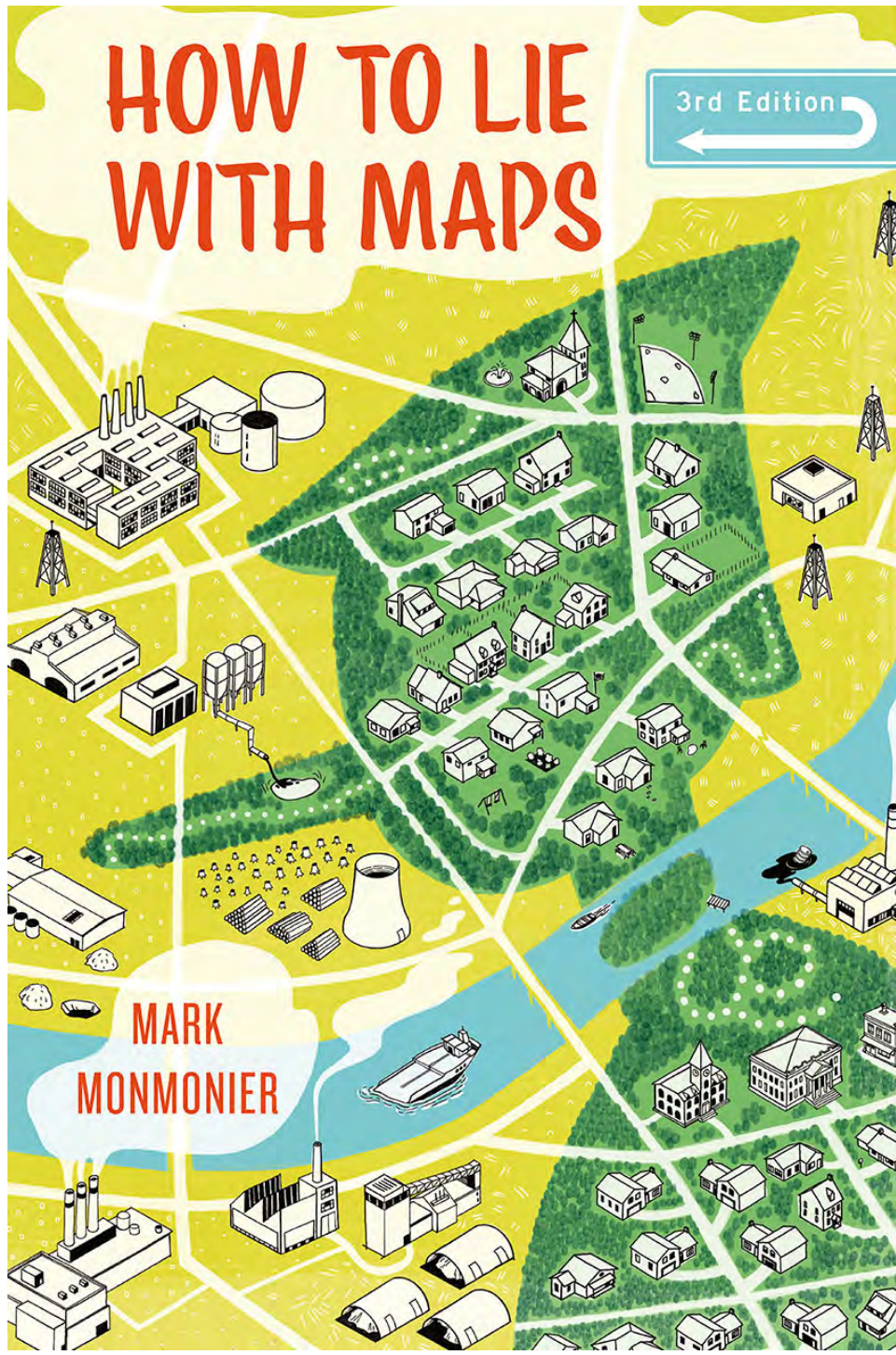


“Maps make good witnesses. In lawsuits over boundaries and land ownership, maps can testify with authority and conviction”

Mark Monmonier, *Drawing the Line: Tales of Maps and Cartocontroversy*

# HOW TO LIE WITH MAPS

3rd Edition



MARK  
MONMONIER

# **The ICJ's view on maps as evidence**

*Burkina Faso/Mali* Judgment (1986), paragraphs 54-56

54. At the present stage of its reasoning the Chamber can confine itself to the statement of a principle. Whether in frontier delimitations or in international territorial conflicts, maps merely constitute information which varies in accuracy from case to case; of themselves, and by virtue solely of their existence, they cannot constitute a territorial title, that is, a document endowed by international law with intrinsic legal force for the purpose of establishing territorial rights. Of course, in some cases maps may acquire such legal force, but where this is so the legal force does not arise solely from their intrinsic merits: it is because such maps fall into the category of physical expressions of the will of the State or States concerned. This is the case, for example, when maps are annexed to an official text of which they form an integral part. Except in this clearly defined case, maps are only extrinsic evidence of varying reliability or unreliability which may be used, along with other evidence of a circumstantial kind, to establish or reconstitute the real facts.

## **The ICJ's view on maps as evidence**

*Burkina Faso/Mali* Judgment (1986), paragraphs 54-56

55. The actual weight to be attributed to maps as evidence depends on a range of considerations. Some of these relate to the technical reliability of the maps. This has considerably increased, owing particularly to the progress achieved by aerial and satellite photography since the 1950s. But the only result is a more faithful rendering of nature by the map, and an increasingly accurate match between the two. Information derived from human intervention, such as the names of places and of geographical features (the toponymy) and the depiction of frontiers and other political boundaries, does not thereby become more reliable. Of course, the reliability of the toponymic information has also increased, although to a lesser degree, owing to verification on the ground; but in the opinion of cartographers, errors are still common in the representation of frontiers, especially when these are shown in border areas to which access is difficult.

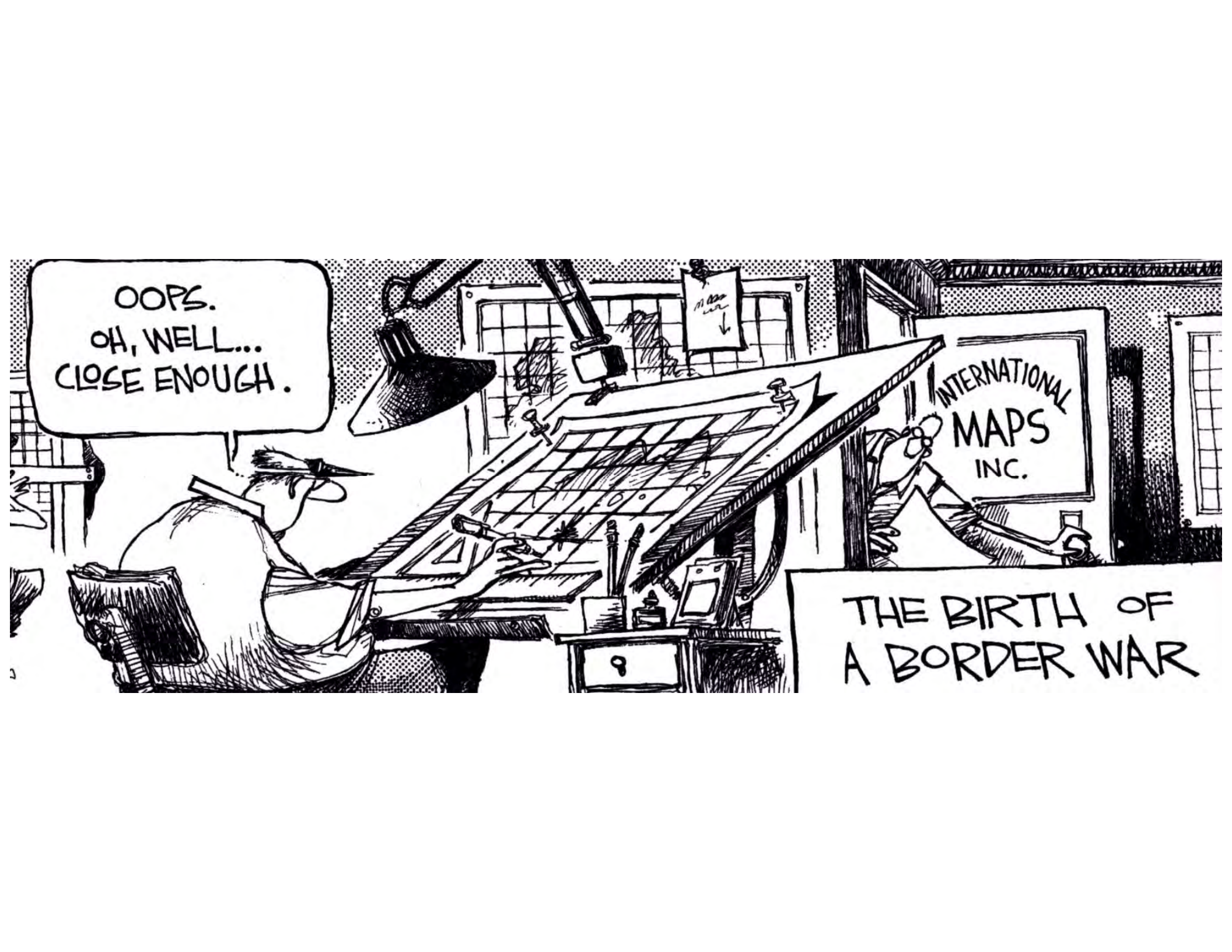
## Toponym troubles...

They talked about Ishmaelia. “No-one knows if it’s got any minerals because no-one’s been to see. The map’s a complete joke,” Bannister explained. “The country has never been surveyed at all; half of it’s unexplored. Why, look here,” he took down a map from his shelves and opened it. “See this place, Laku. It’s marked as a town of some five thousand inhabitants, fifty miles north of Jacksonburg. Well, there has never been such a place. Laku is the Ishmaelite for ‘I don’t know’. When the boundary commission were trying to get through to the Sudan in 1898 they made a camp there and asked one of their boys the name of the hill, so as to record it in their log. He said ‘Laku’, and they’ve copied it from map to map ever since.

Evelyn Waugh: *Scoop* (1938)







OOPS.  
OH, WELL...  
CLOSE ENOUGH.

INTERNATIONAL  
MAPS  
INC.

THE BIRTH OF  
A BORDER WAR

## The ICJ's view on maps as evidence

*Burkina Faso/Mali* Judgment (1986), paragraphs 54-56

56. Other considerations which determine the weight of maps as evidence relate to the neutrality of their sources towards the dispute in question and the parties to that dispute. Since relatively distant times, judicial decisions have treated maps with a considerable degree of caution: less so in more recent decisions, at least as regards the technical reliability of maps. But even where the guarantees described above are present, maps can still have no greater legal value than that of corroborative evidence endorsing a conclusion at which a court has arrived by other means unconnected with the maps. In consequence, except when the maps are in the category of a physical expression of the will of the State, they cannot in themselves alone be treated as evidence of a frontier, since in that event they would form an irrebuttable presumption, tantamount in fact to legal title. The only value they possess is as evidence of an auxiliary or confirmatory kind, and this also means that they cannot be given the character of a rebuttable or *juris tantum* presumption such as to effect a reversal of the onus of proof.

## A more memorable summary

“As the Court will be aware, all maps are not equal. Shakespeare wrote that some men are born great, some achieve greatness and some have greatness thrust upon them. Now whether this is true for men, it is certainly true for maps.

Some maps are born great – in particular, those annexed to treaties.

... Then there are maps that achieve greatness, because they are endorsed and put forward by States in the context of international relations as reflecting a boundary, and maybe they are accepted by other States as well...

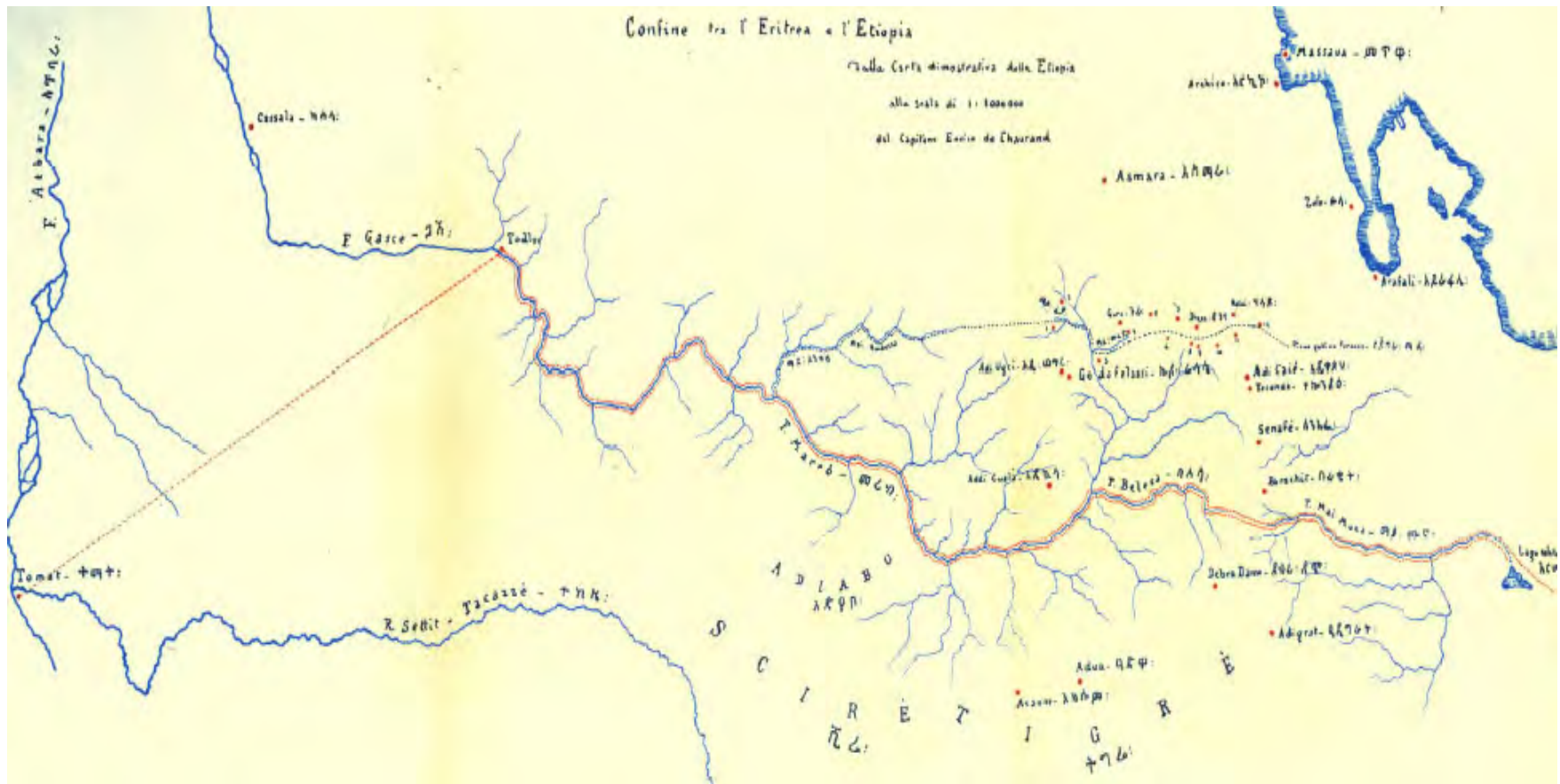
... And then there are ...the miscellaneous maps, the maps that are none of the above, the maps that have no international endorsement at all. ... They are more or less reliable or more or less unreliable depictions, on some scale or another, of something or another. They may be privately published; they may be internal maps which have never been published at all. ... [Such maps] “merely constitute information which varies in accuracy from case to case; of themselves and by virtue solely of their existence, they cannot constitute a territorial title, that . . . a document endorsed by international law with intrinsic legal force for the purpose of establishing territorial rights [can do]...”.”

Professor James Crawford, *Sovereignty over Pulau Ligitan and Pulau Sipadan (Indonesia/Malaysia)*, oral hearings, June 2002

# A great map...

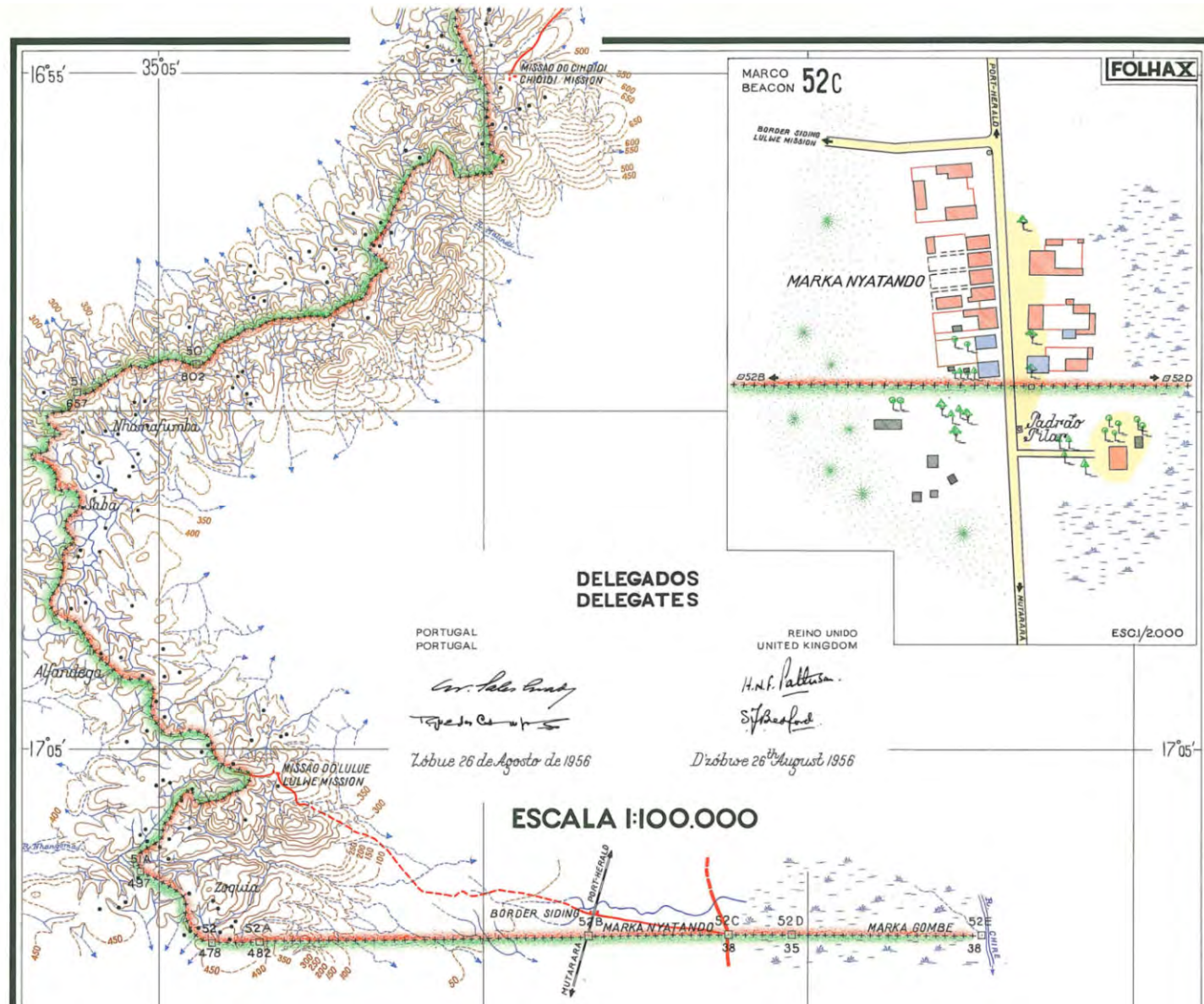
Map attached to Eritrea-Ethiopia boundary agreement 1900

“The line Tomat-Todluc-Mareb-Belesa-Muna, traced on the map annexed, is recognized by the two Contracting Parties as the boundary between Eritrea and Ethiopia.”



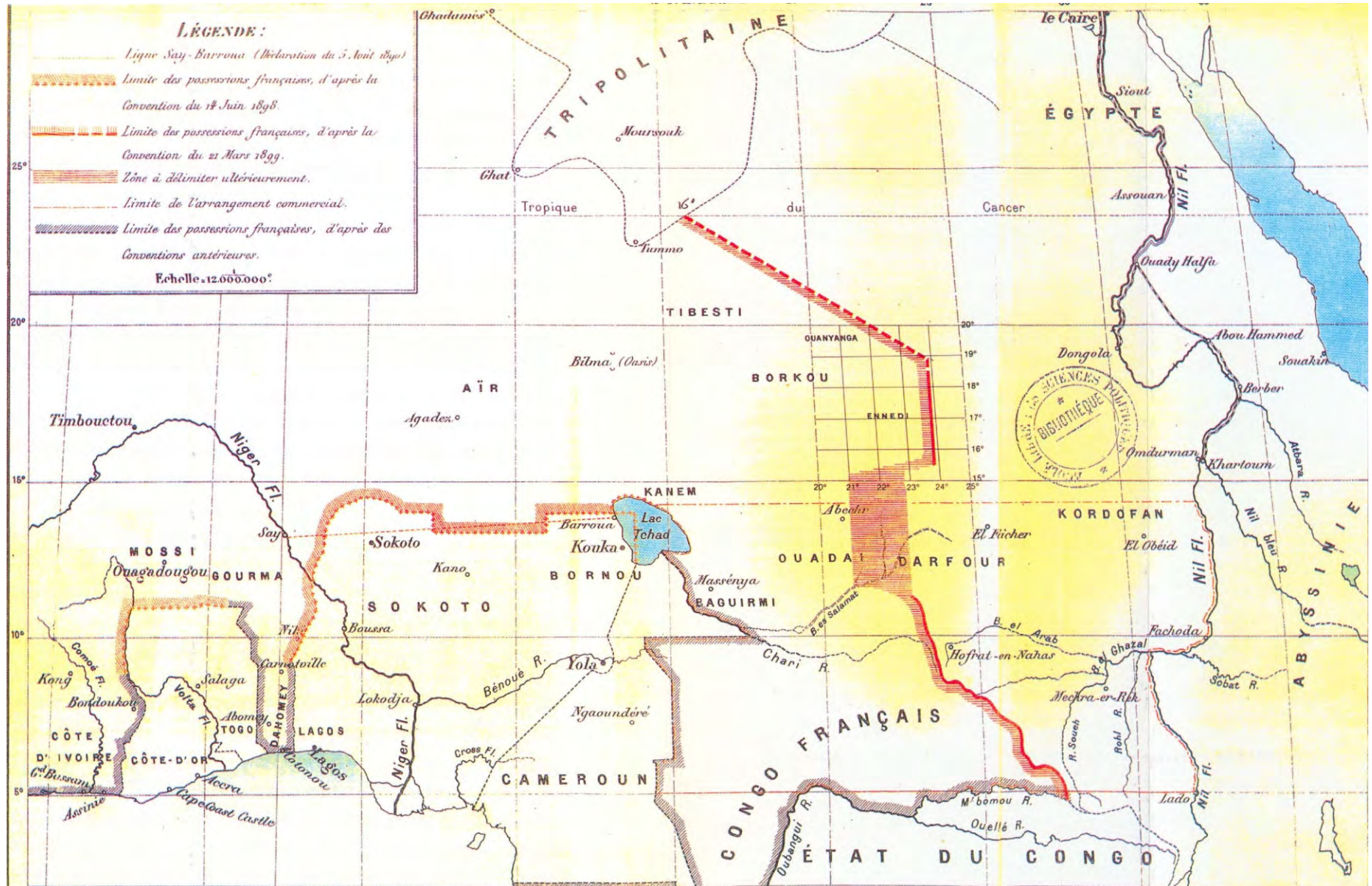
# Not a great map...

## Malawi-Mozambique demarcation map 1956



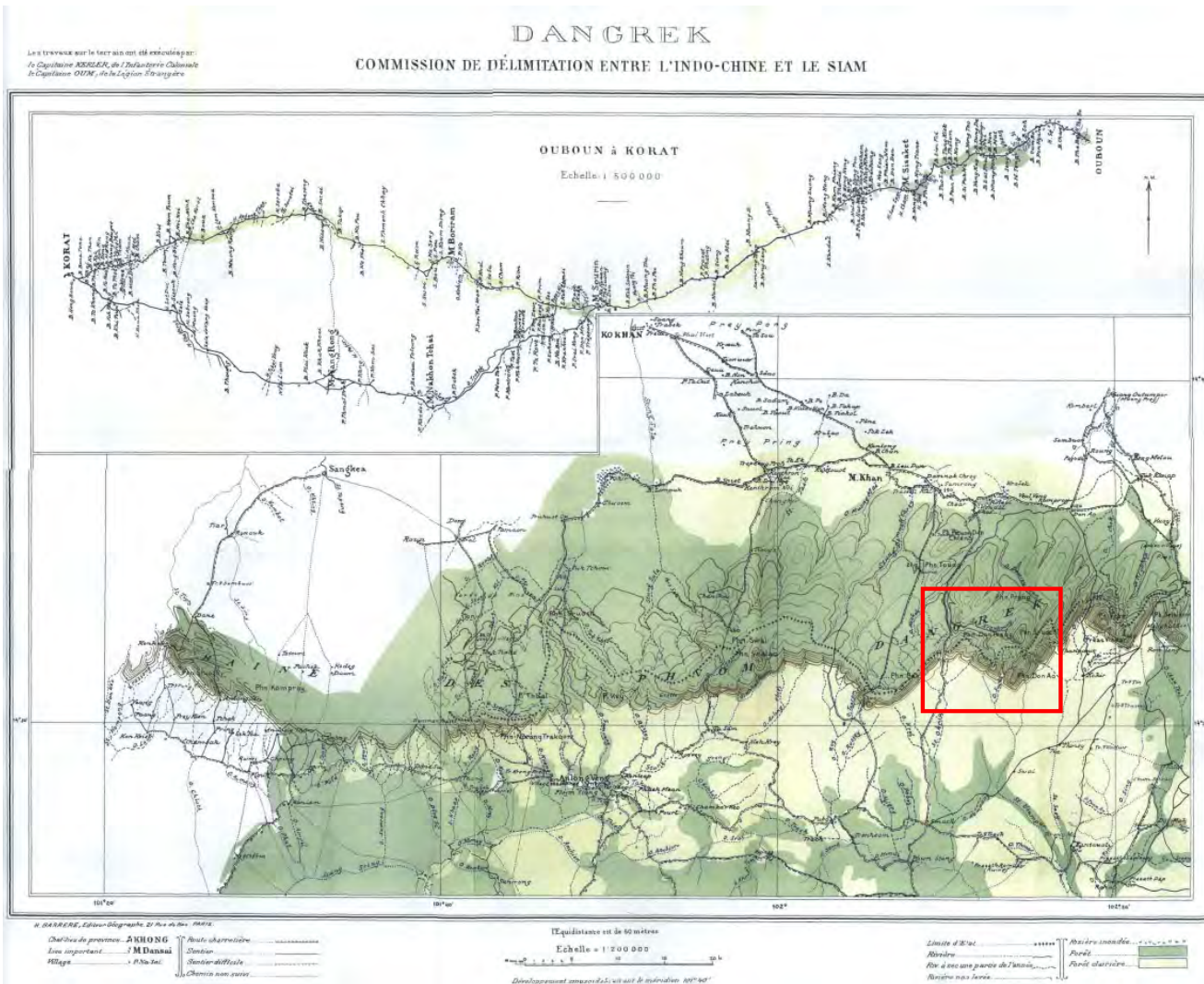
# A map which achieved greatness

## The French *Livre Jaune* map (Libya/Chad)



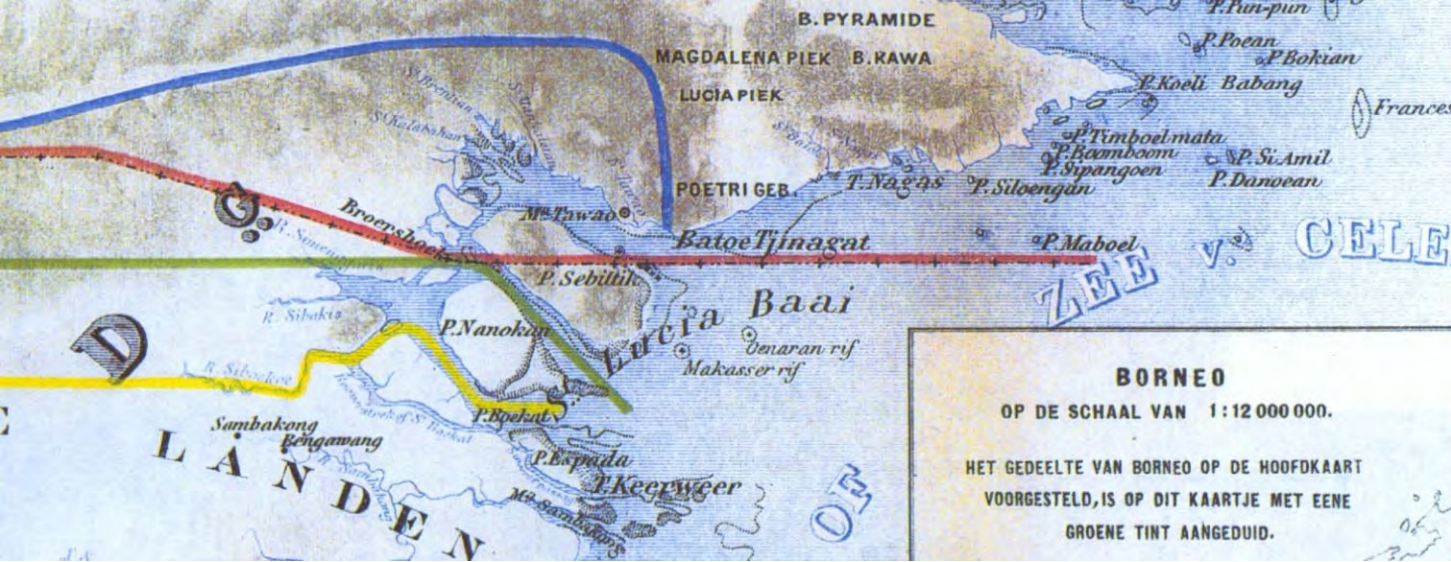
# A map which achieved greatness

## Cambodia-Thailand 'Annex 1' map



# A map which didn't quite achieve greatness

Anglo-Dutch boundary map, 1891 (Indonesia-Malaysia)





## Non-treaty maps

“The effect of a map that is not part of a treaty will vary according to its provenance, its scale and cartographic quality, its consistency with other maps, the use made of it by the parties, the degree of publicity accorded to it and the extent to which, if at all, it was adopted or acquiesced in by the parties adversely affected by it, or the extent to which it is contrary to the interests of the party that produced it.

A map that is known to have been used in negotiations may have a special importance. A map that emanates from third parties (albeit depending on the circumstances), or is on so small a scale that its import becomes a matter for speculation rather than precise observation, is unlikely to have great legal or evidentiary value. But a map produced by an official government agency of a party, on a scale sufficient to enable its portrayal of the disputed boundary area to be identifiable, which is generally available for purchase or examination, whether in the country of origin or elsewhere, and acted upon, or not reacted to, by the adversely affected party, can be expected to have significant legal consequences.”

*Eritrea-Ethiopia Boundary Commission, 13 April 2002 decision, paras. 3.21-22*

## Non-treaty maps

“...it cannot be the case that non-agreed maps, produced, acted upon or adopted unilaterally by a Party, even if they have no conclusive weight or effect themselves, must, merely on account of their unilateral provenance, be regarded as devoid of all value.”

*1977 Beagle Channel arbitral award, para. 141*

“Since the Tribunal has arrived at its legal conclusions about the status of the islands on the basis of the diplomatic record and agreements entered into between 1923 and 1939, the map evidence – whilst supportive of and consistent with the conclusions reached – is not itself determinative. Were there no other evidence in the record concerning the attitude or intentions of Italy, this evidence would be of greater importance.”

*Eritrea-Yemen arbitral award, Phase I, para. 375*

## Map consistency

“...in light of the uncertainty and inconsistency of the cartographic material submitted to it, the Court considers itself unable to draw conclusions from the map evidence produced in this case.”

*Kasikili/Sedudu (Botswana/Namibia) ICJ judgment, para. 87.*

“...in considering the general significance of map evidence, if that evidence is uncertain and inconsistent, its value will be reduced in relation to the endorsement of a conclusion arrived at by other means...”

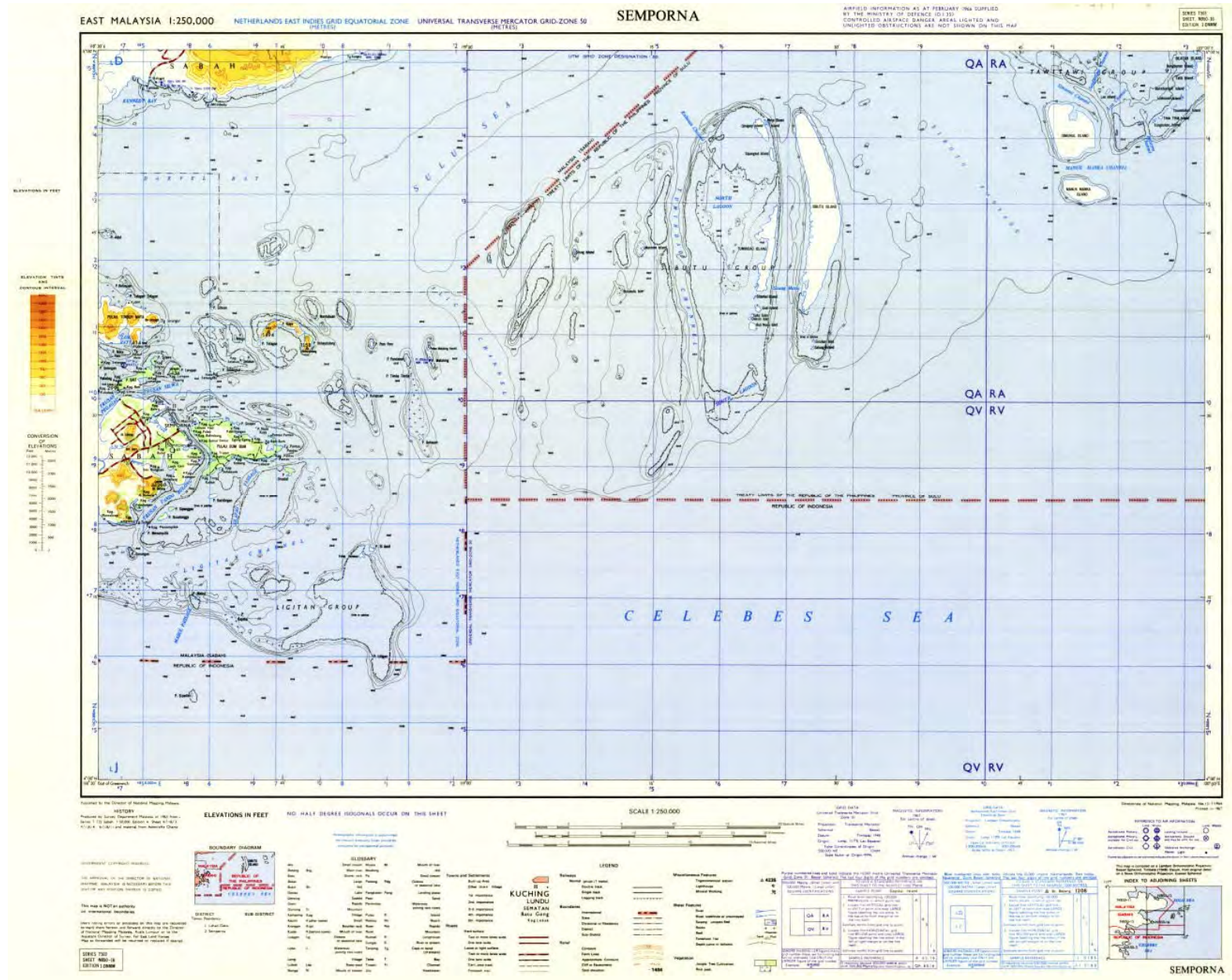
*Eritrea-Ethiopia Boundary Commission, 13 April 2002 decision, para. 3.25.*

## The Eritrea-Ethiopia ‘classical signature’

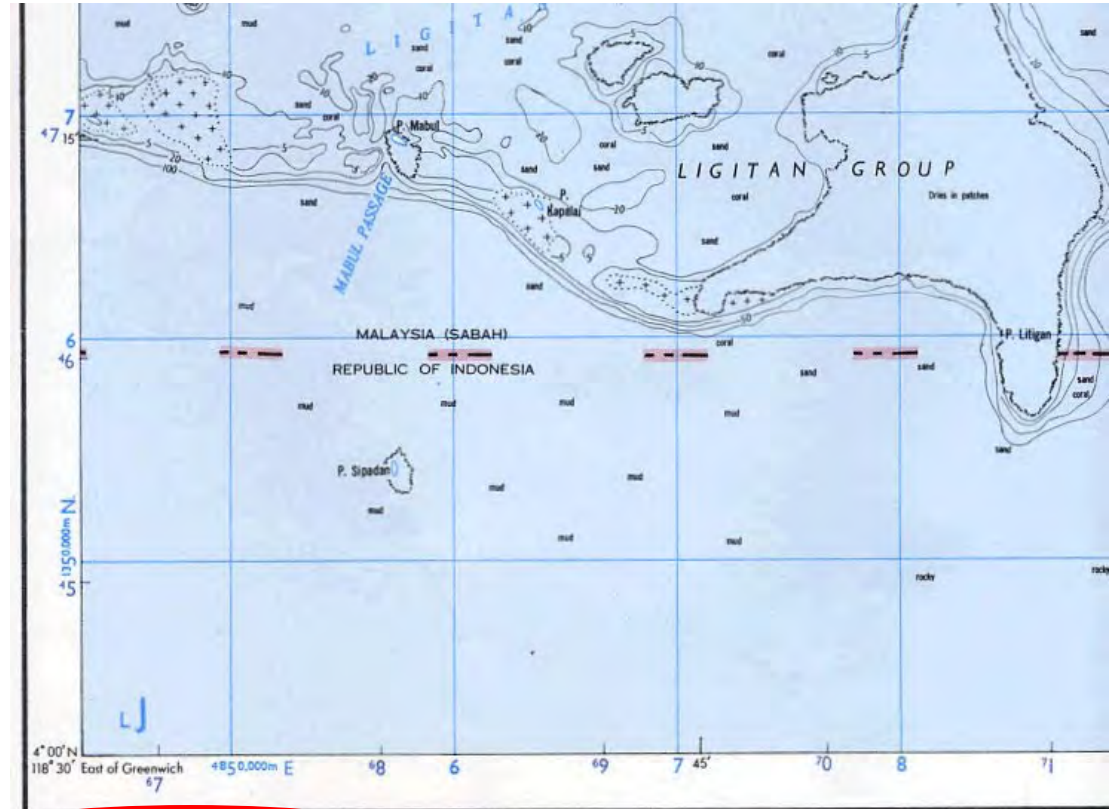
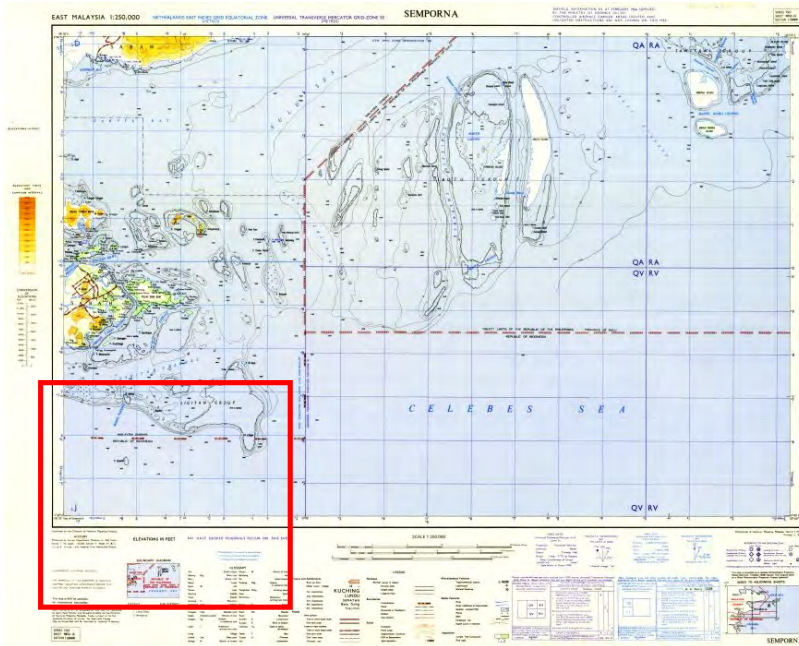
“The Commission has taken into account the many maps presented to it in evidence, but has only given weight in relation to this sector to maps produced by the Parties themselves in the period prior to 1935. It has noted that three early Italian maps show the Ethiopian claim line, as does one Ethiopian map of 1923. However, all the other relevant maps show the Eritrean claim line in accordance with what has, in the present proceedings, come to be called the ‘classical’ or ‘traditional’ signature characterized by a straight line from the confluence of the Tomsa with the Setit (Point 6) to Point 9 at an angle of about 28° from true north. There is no record of any timely Ethiopian objection to these maps and there is, moreover, a consistent record of Ethiopian maps showing the same boundary. These maps amount to subsequent conduct or practice of the Parties evidencing their mutual acceptance of a boundary corresponding to the Eritrean claim line.”



# Maps as admissions against interest Indonesia/Malaysia



# Maps as admissions against interest Indonesia/Malaysia



Published by the Director of National Mapping, Malaysia.

**HISTORY**  
Produced by Survey Department Malaysia in 1965 from:-  
Series T 715 Sabah 1:50,000 Edition 4 Sheet 4/118/3  
4/118/4 4/118/11 and material from Admiralty Charts

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THE APPROVAL OF THE DIRECTOR OF NATIONAL  
MAPPING MALAYSIA IS NECESSARY BEFORE THIS  
MAP OR ANY PORTION THEREOF IS COPIED

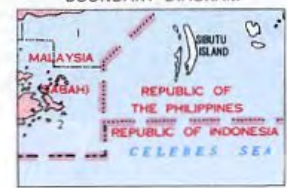
This map is NOT an authority  
on international boundaries.

**ELEVATIONS IN FEET**

**NO HALF DEGREE ISOGONALS OCCUR C**

Hydrographic information is approximate  
the relevant Admiralty Chart should be  
consulted for navigational purposes

**BOUNDARY DIAGRAM**



DISTRICT SUB-DISTRICT

- Alo
- Batu Batq
- Batu
- Besar
- Bukit Bt
- Danau
- Genting
- Gum
- Gunong G
- Kampong Koo

**GLOSSARY**

- Small stream Muara M
- Main river Mudong
- Stone, rock Pa
- Large Padang Pdg
- Hill
- Lake Pangkatan Pang
- Saddle Pasir
- Rapids Permintas
- Mountain
- Village Pulau P

## Map disclaimers

“3.27 The Commission is of the view that such disclaimers do not automatically deprive a map of all evidential value. The map still stands as an indication that, at the time and place the map was made, a cartographer took a particular view of the features appearing on the map. The disclaimer is merely an indication that the body making the map (or its Government) is not to be treated as having accorded legal recognition to the boundaries marked thereon or to the title to territory of the States concerned as indicated by the marked boundary.

3.28 As regards the State adversely affected by the map, a disclaimer cannot be assumed to relieve it of the need that might otherwise exist for it to protest against the representation of the feature in question. Nor does the disclaimer (whatever may be its legal effect on the content of the map) neutralize the fact that that State itself published the map in question.”

*Eritrea-Ethiopia Boundary Commission, 13 April 2002 decision*

# Maps as evidence in boundary cases: conclusions

- Judicial bodies are generally sceptical about the evidentiary value of maps which are not “physical expressions of the will of the State or States concerned”.
- Non-treaty maps can become such physical expressions through their treatment by the States, but maps published by state bodies which appear to be admissions against interest rarely fall into this category.
- In the absence of any other evidence of title / boundary alignment, maps which are not considered physical expressions of the will of the States can have evidentiary value - but even minor *effectivités* are likely to trump map evidence.
- States can agree to treat any map as authoritative. But if they don't agree on the value of a particular map, it is important to understand the judicial perspective.



# The evolution of mapping techniques

Mid-19<sup>th</sup> century: By compilation from travellers' reports - good & bad

Early 20<sup>th</sup> century: Radio time signals; Plane tabling introduced: much depended on the skill of the surveyor

Mid-20<sup>th</sup> century: Aerial photography provides first complete overview of topography

Late 20<sup>th</sup> century / early 21<sup>st</sup> century: satellite-assisted positioning, satellite imagery, GIS

# Assessing map quality

- Who produced it? What was their reputation?
- When was the map created? Was it revised over time?
- How detailed is the map content, especially contours and drainage? What is the density of names and human-constructed features?
- What coordinate system is used? Is a datum specified?
- Are there map features which still exist today whose coordinates can be checked? If not, are there other (non-derivate) maps which can corroborate the map's content?
- Does the boundary depicted on the map make sense in relation to the landscape?

# Map interpretation and evaluation

## Algeria-Libya

“From Ghat to Tummo, the border will be determined by the ridge of the mountains that stretch between these two locations”

Franco-Italian Exchange of Notes of 12 September 1919



# Map interpretation and evaluation

## Algeria-Libya

“From Ghat to Tummo, the border will be determined by the ridge of the mountains that stretch between these two locations”

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# Map interpretation and evaluation

## Algeria-Libya

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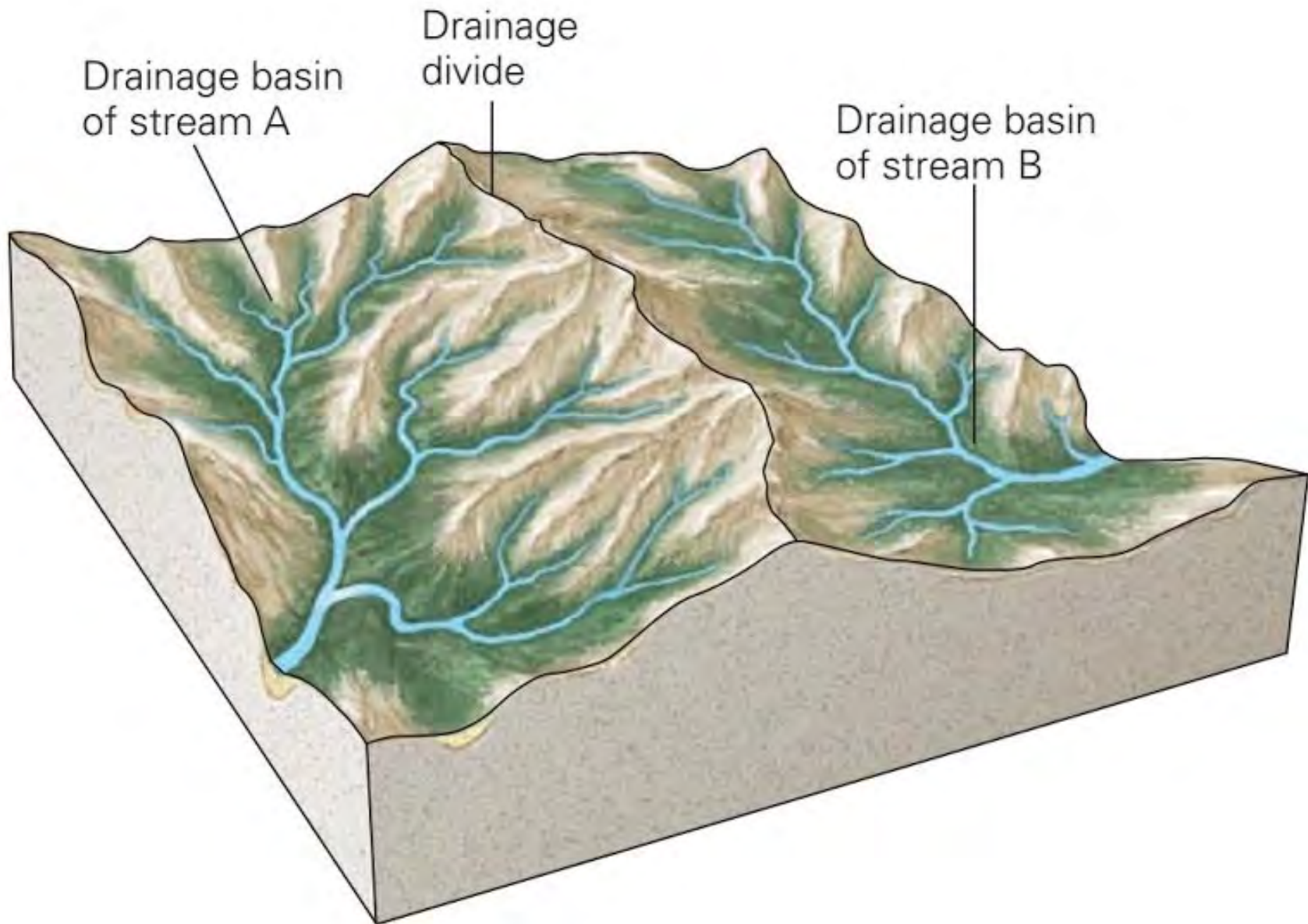




## **Convention between France and Siam, February 1904**

“The frontier between Siam and Cambodia starts, on the left bank of the Great Lake, at the mouth of the River Stung Roluos; from this point it follows the parallel towards the east until it meets the River Prek-Kompong-Tiam, then, turning towards the north, it follows the meridian from this point of meeting as far as the Pnom Dang Rek (Dangrek) chain of mountains. Thence it follows the line of the watershed between the basins of the Nam-Sen and the Mekong, on one side, and the Nam-Moun, on the other side, and rejoins the Pnom-Padang chain, the crest of which it follows to the east as far as the Mekong. Upstream from this point the Mekong remains the frontier of the Kingdom of Siam, in conformity with Article 1 of the Treaty of the 3rd October, 1893.”

# Watershed (drainage divide) boundaries





# Watershed boundaries

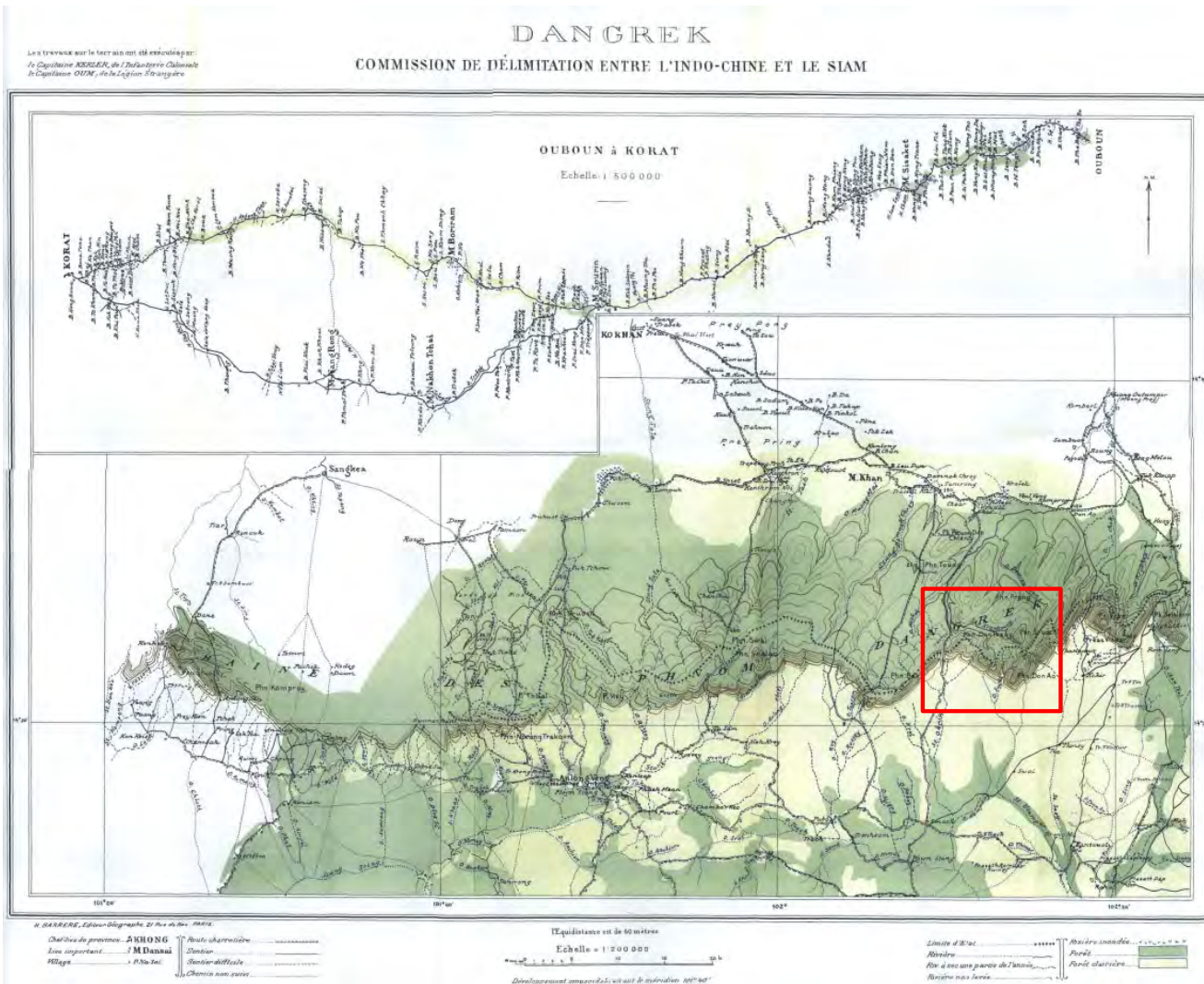


# Watershed boundaries: the Dangrek mountains



# Map interpretation and evaluation

## The Cambodia-Thailand “Annex I” map



# Temple of Preah Vihear



Photo courtesy of Megan Gates

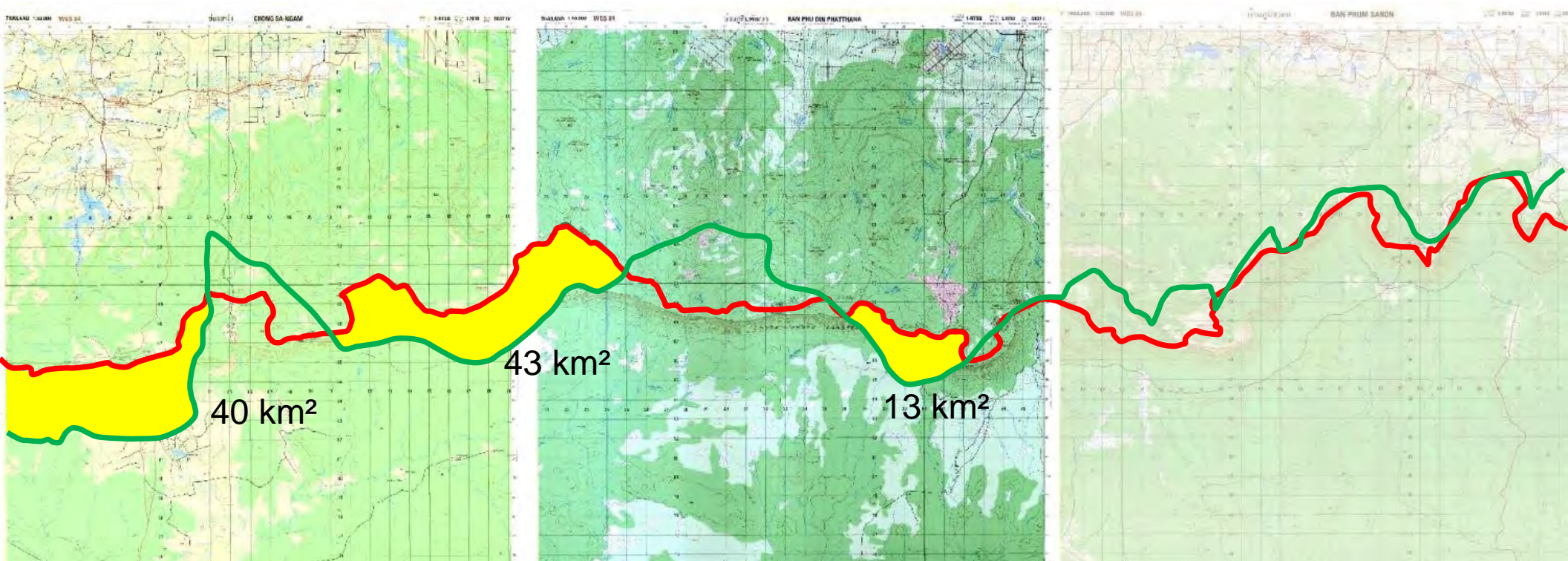
# Map interpretation and evaluation

## The Cambodia-Thailand “Annex I” map



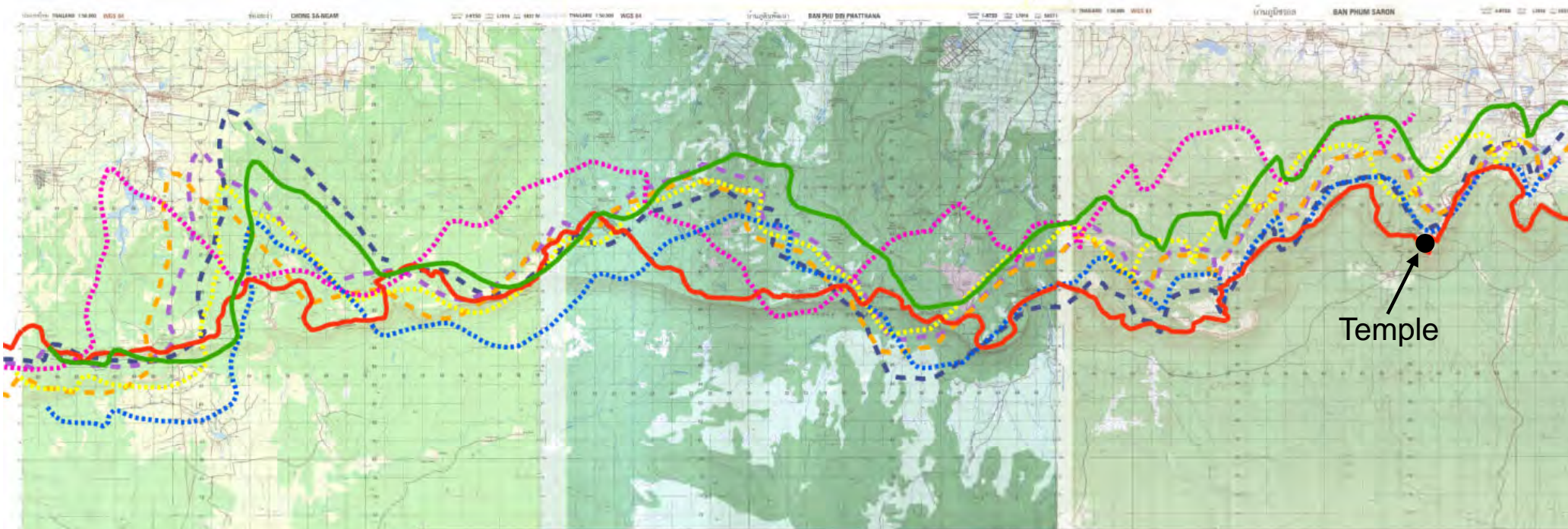
# Map interpretation and evaluation

## The Cambodia-Thailand “Annex I” map



# Map interpretation and evaluation

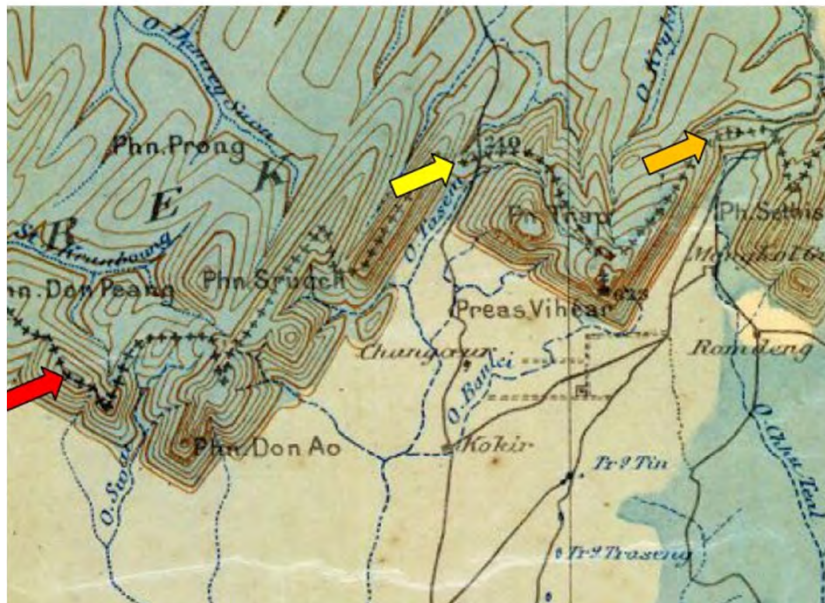
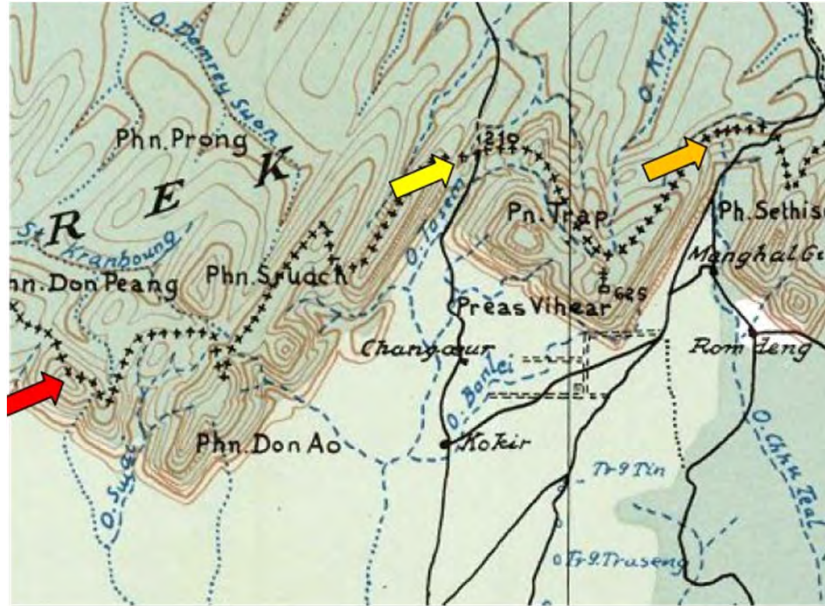
## The Cambodia-Thailand “Annex I” map



- Watershed on Royal Thai Survey Department map sheets
- Annex 1 map boundary after transposition of coordinates
- Annex 1 map boundary after Temple transformation
- Annex 1 map boundary after Ph Sruogh transformation
- Annex 1 map boundary after Ph Swai transformation
- - - - Annex 1 map boundary after scaling & rotation (points 2 & 14)
- - - - Annex 1 map boundary after scaling & rotation (points 4 & 14)
- - - - Annex 1 map boundary after segmented scaling & rotation (points 4 & 7, 7 & 9, 9 & 11, 11 & 13, 13 & 14)

# Map interpretation and evaluation

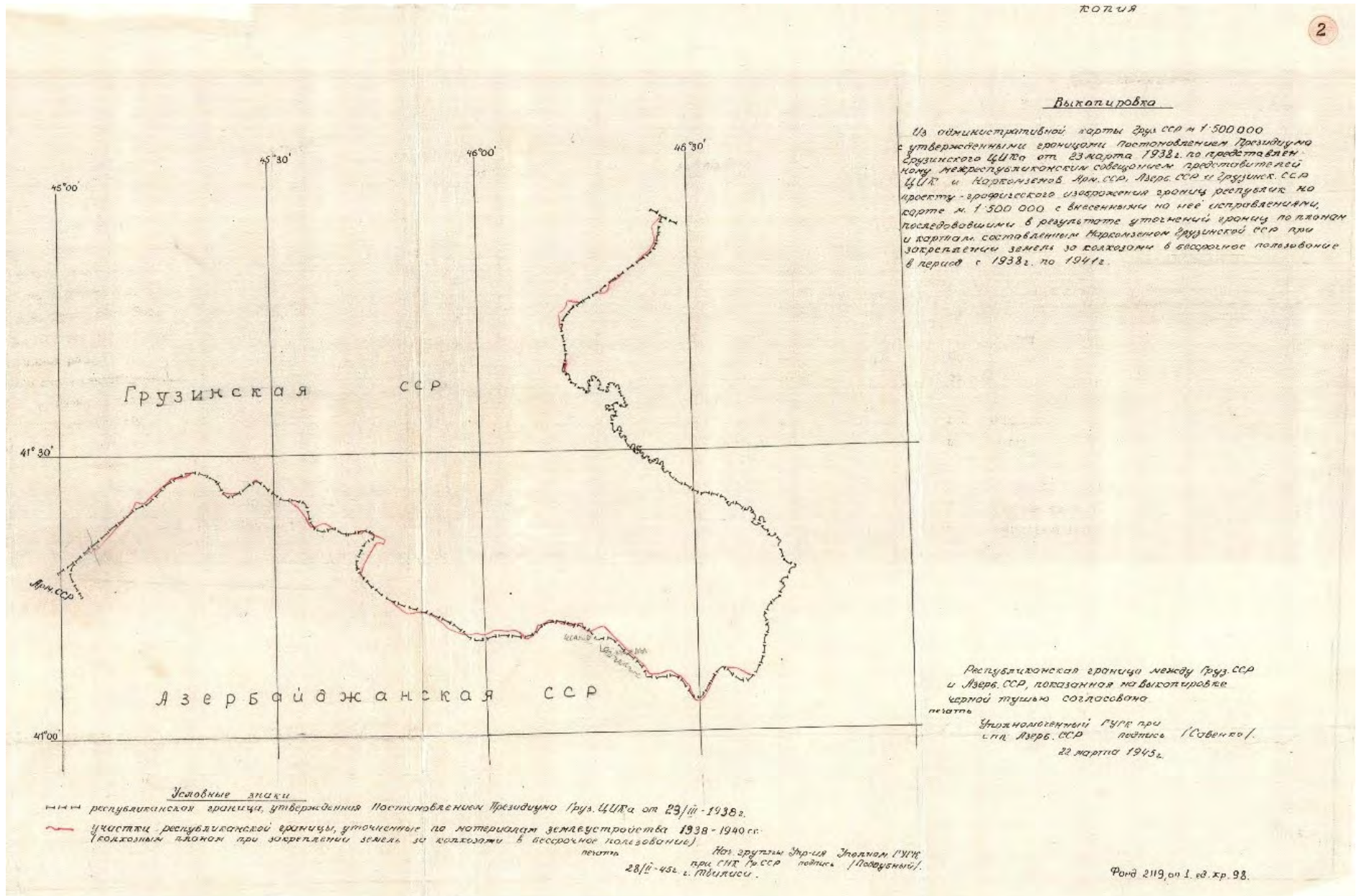
## The Cambodia-Thailand “Annex I” map





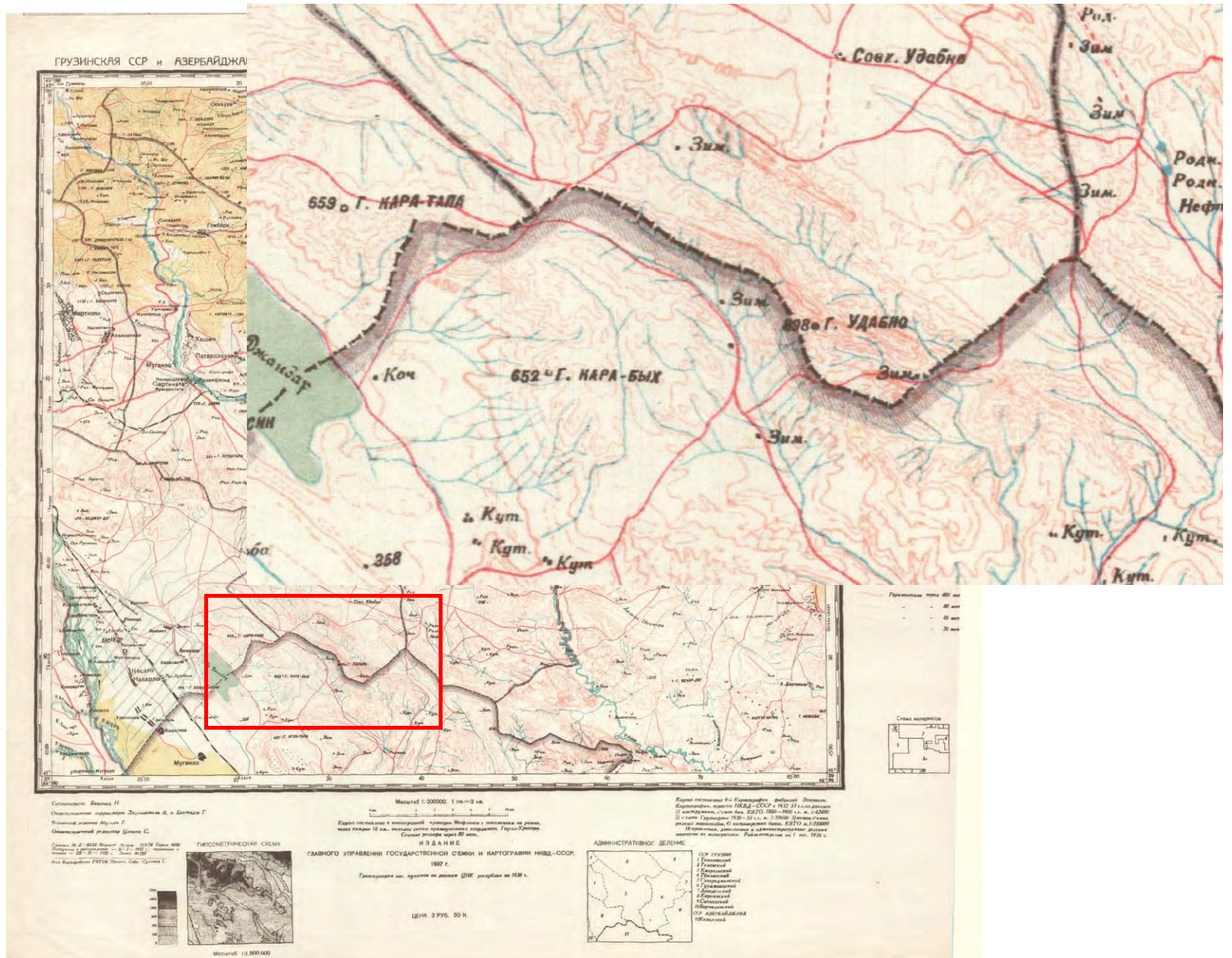
# Map interpretation and evaluation

## The Georgia "cartographers case"



# Map interpretation and evaluation

## The Georgia “cartographers case”



# Map research resources

- Government archives
  - National
  - Local
  - Imperial / colonial
  - Survey and hydrographic departments
- International organisation archives, e.g. United Nations
- National and academic libraries (e.g. British Library = 4.5 million maps)
- University collections, e.g. Durham Sudan Archive
- Learned society collections, e.g. Royal Geographical Society
- Business archives, e.g. oil & gas companies
- Personal archives
- *World Directory of Map Collections* (2000, ed. O. Loiseaux)
  - 714 collections in 121 countries

# Practical aspects of map research

- Access to collections / archives
- Organisation of maps in archives
- Preservation / physical condition
- Copying
  - technical challenges
  - cost
  - copyright issues

# Archive research in boundary recovery

## UK national archives



# Archive research in boundary recovery

## XXX survey department archives



# Map research is about more than just the map

- What was the purpose the map?
- Who produced it for whom?
- What source material was used to compile the map?
- Were there multiple versions? Were they all the same?
- How widely was it distributed?
- Did anyone comment on the map?
- What are the strengths and weaknesses of the map in the context of the dispute?
- Remember metadata and marginalia

Title, series, sheet no., publisher, publication date, edition, dates of revisions, scale, other marginal information, archive reference no. etc.

# Historical aerial photography

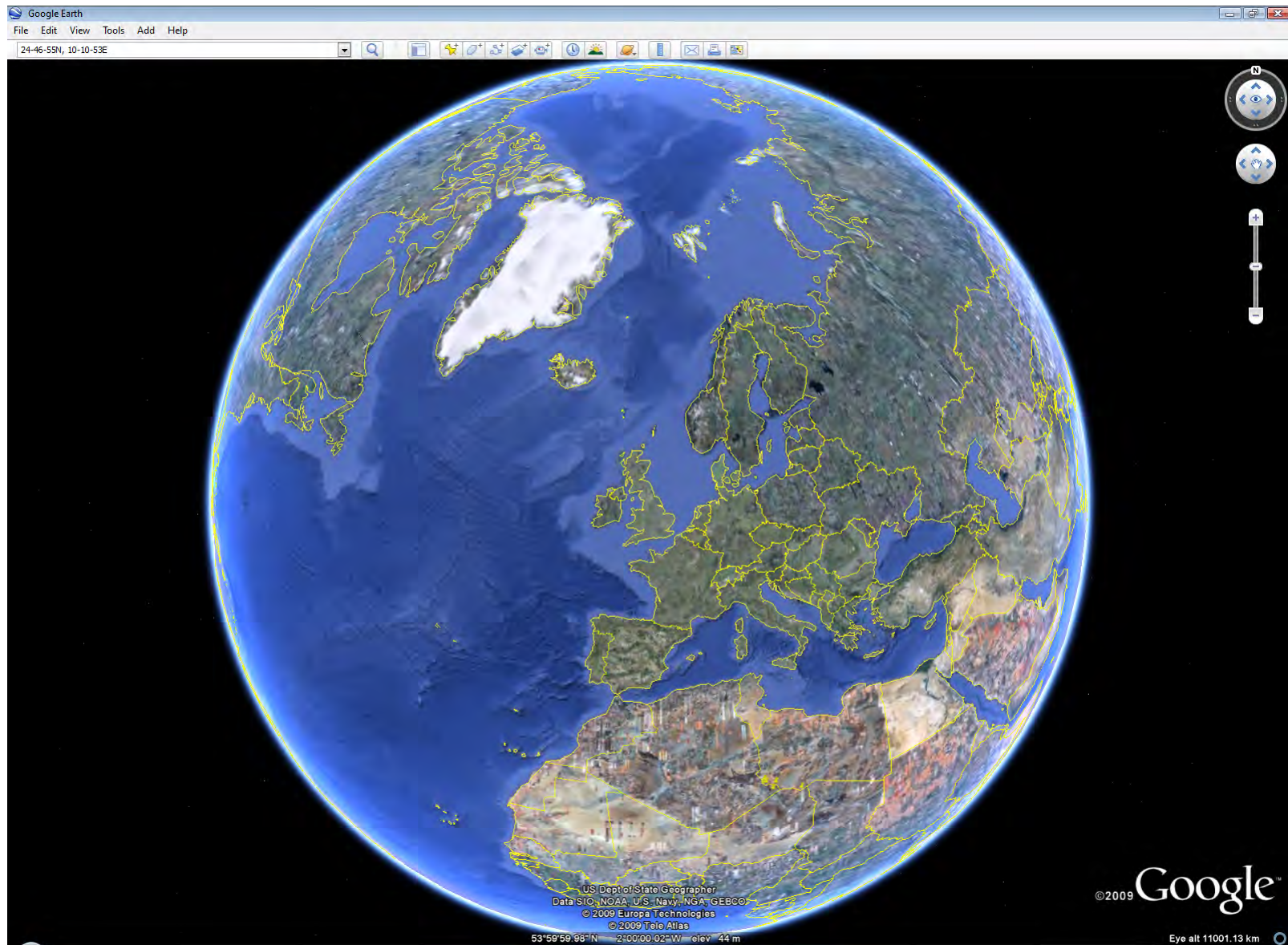


Source: Hebrew University of Jerusalem Aerial Photography Archive

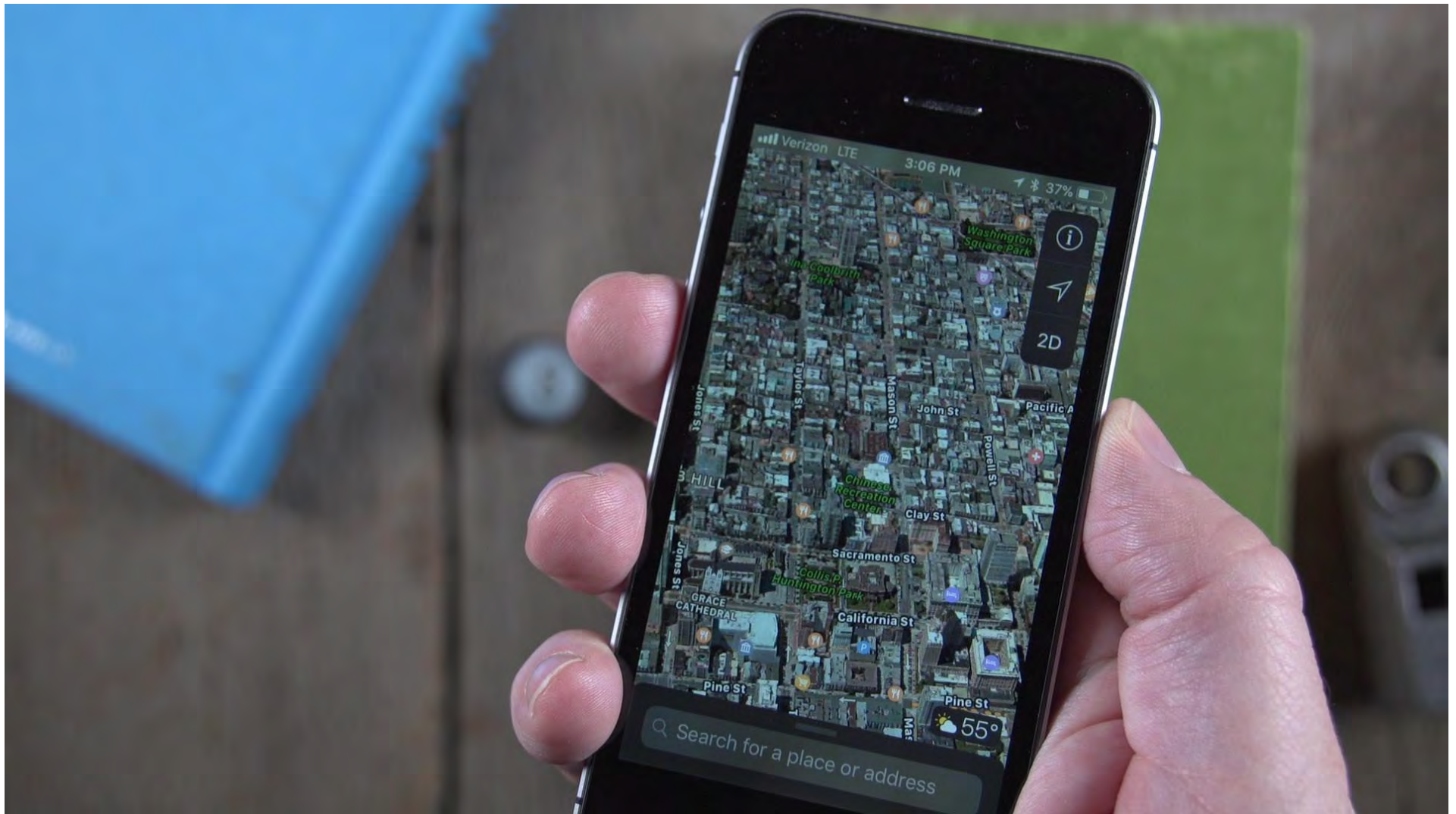




# The imagery revolution: Google Earth etc



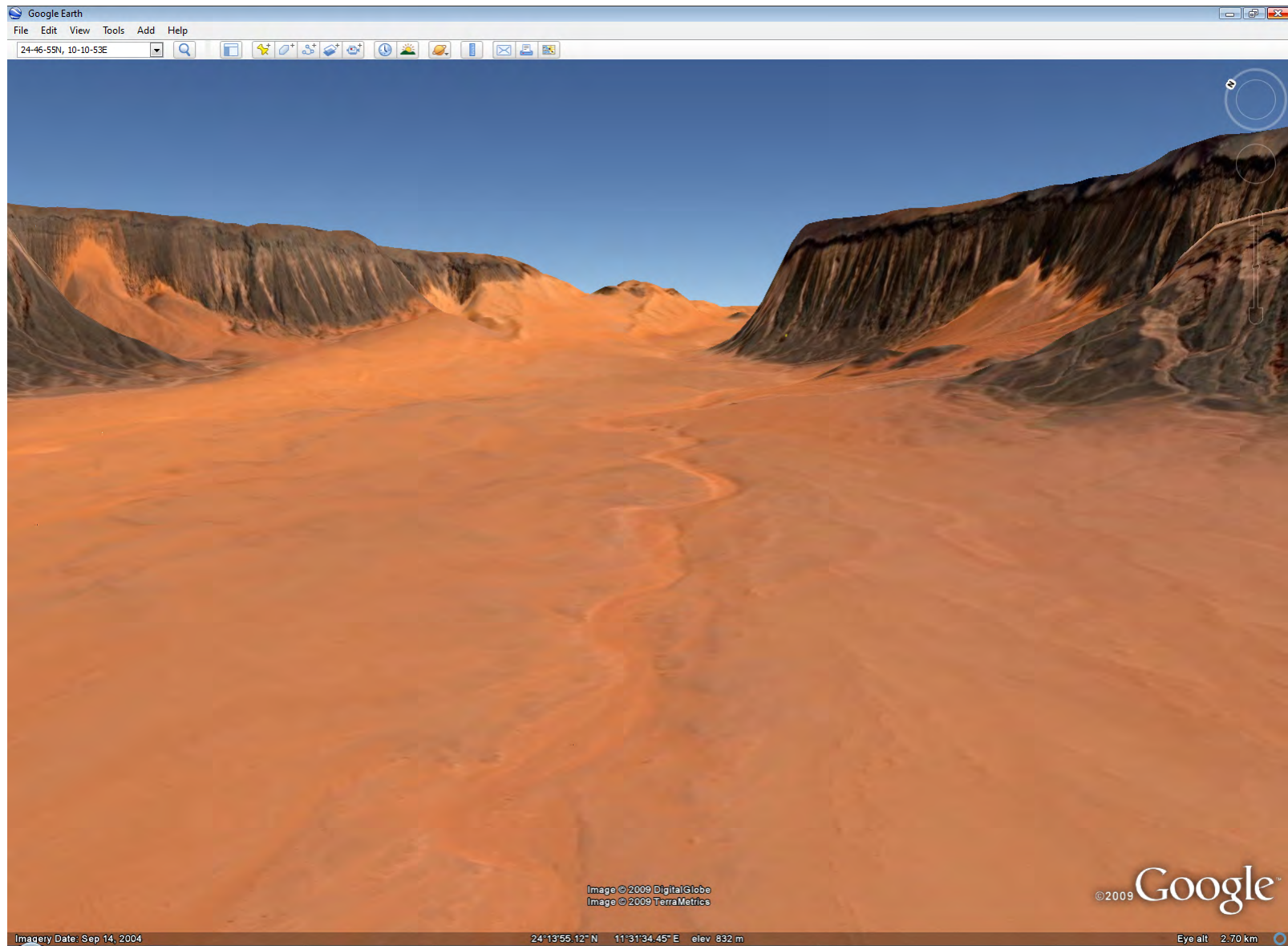
# The imagery revolution: Google Earth etc



# The imagery revolution: Google Earth etc



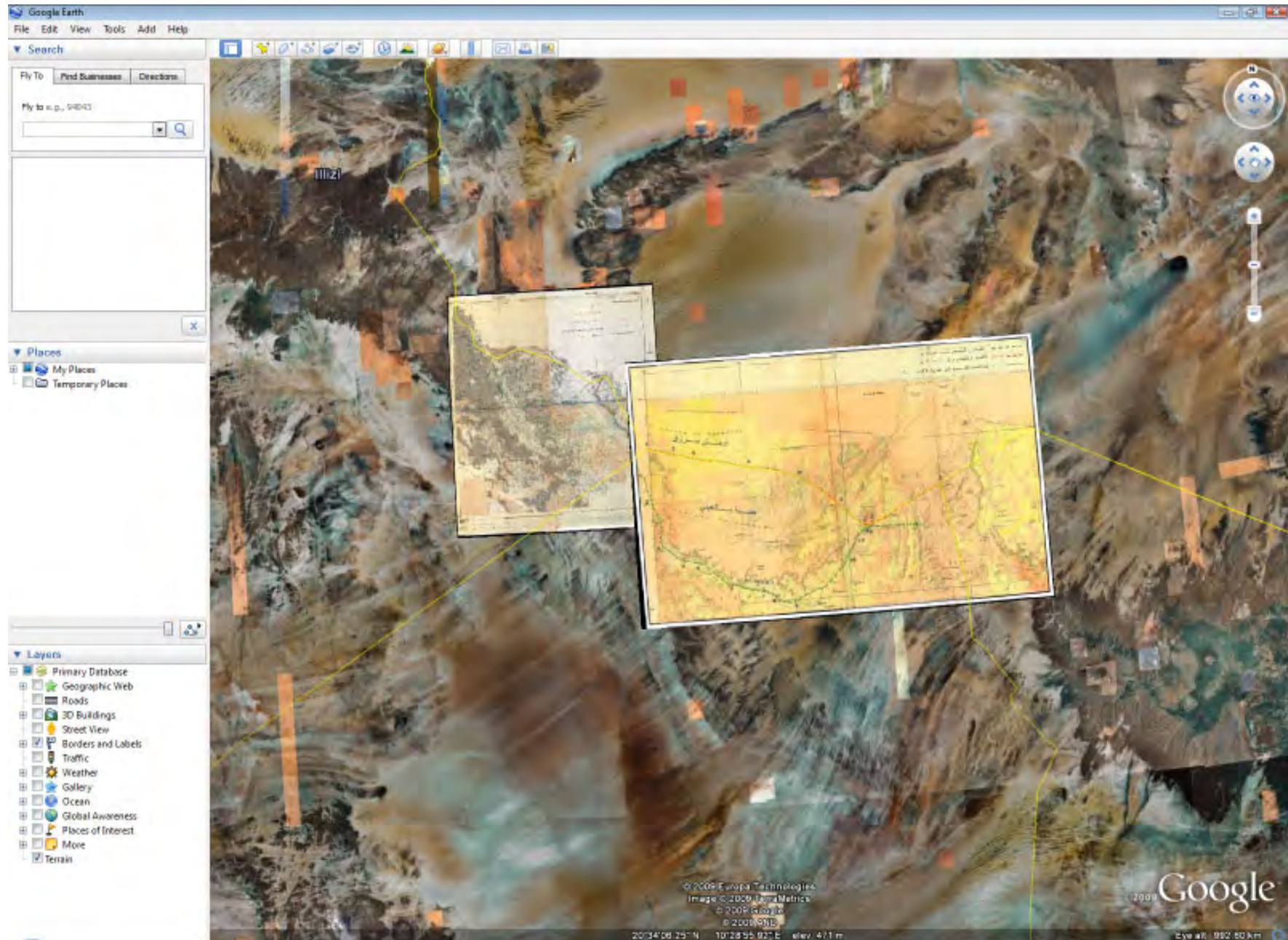
# The imagery revolution: Google Earth etc



# 3D fly-throughs for landscape visualisation

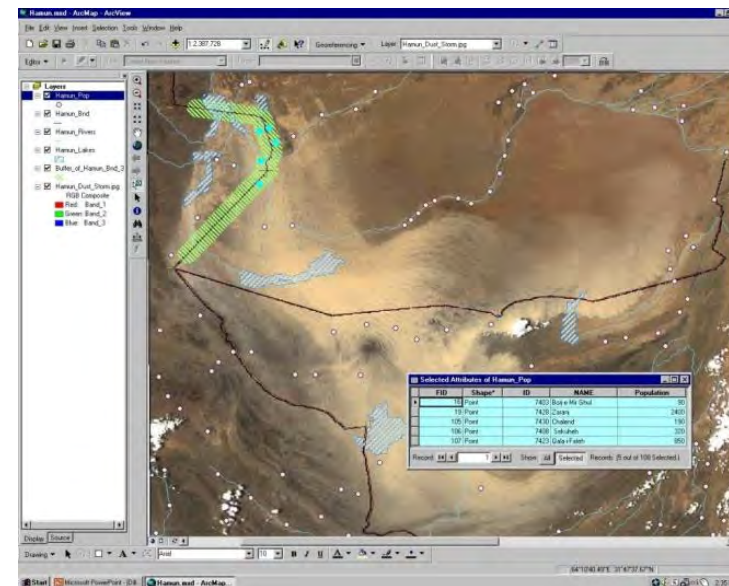
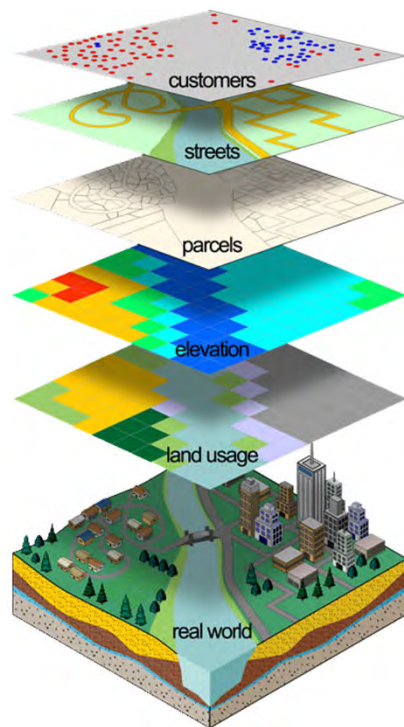


# Combining maps & imagery



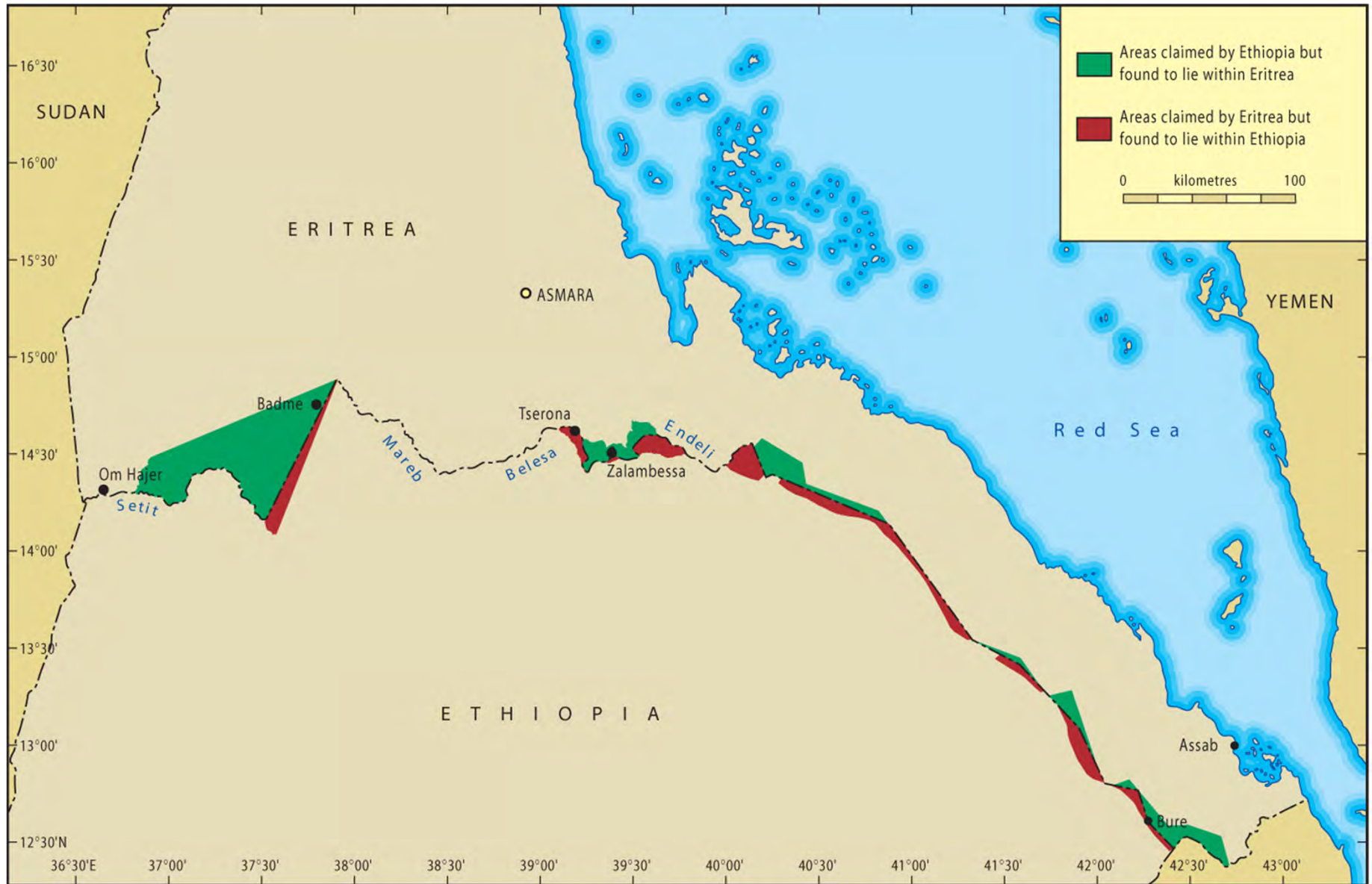
# Elements of a Boundary Information System

- Treaty texts
- Maps / imagery
- Demarcation records
- Maintenance records
- Property ownership records
- Natural resources
- Border infrastructure
- Cross-border flows
- Border incursions
- Environmentally-sensitive areas





# Eritrea-Ethiopia 'virtual demarcation'

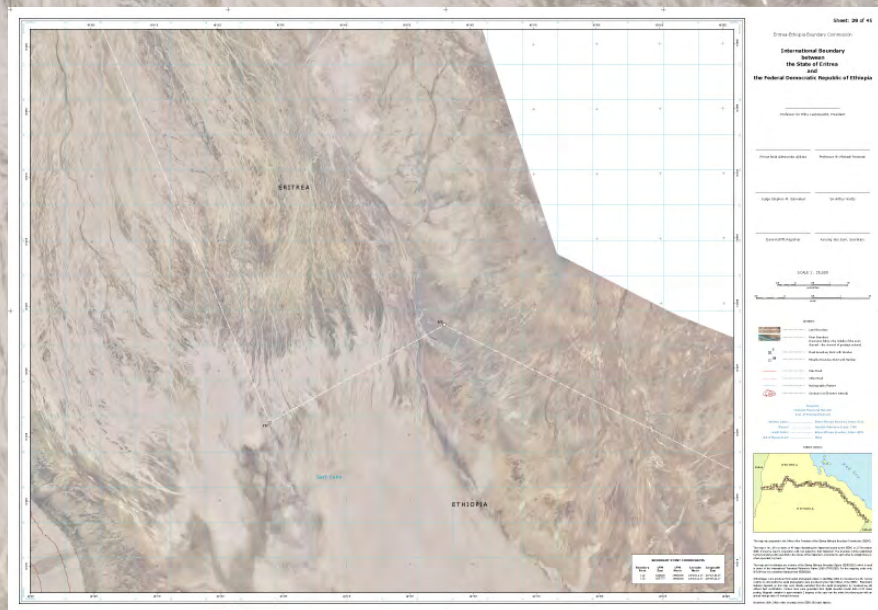


## **Eritrea-Ethiopia ‘virtual demarcation’**

“In view of the subsequent lack of necessary cooperation by the Parties, extending over more than four years, preventing the Commission from fixing boundary pillars on the ground, the Commission decided that it would instead use modern techniques of image processing and terrain modelling, combined with high resolution aerial photography, as well as knowledge acquired on the ground by the Commission field staff, to identify the locations where the line of the boundary changes direction and where boundary pillars would otherwise be located.

These boundary points have been marked on 45 large scale maps (1:25,000) which have been given to the Parties. They have thus been informed in precise detail of where the demarcated boundary will run....

# Eritrea-Ethiopia 'virtual demarcation'



# Mapping of demarcated boundaries

Are new dedicated boundary maps necessary? Who would use them? How often would they need to be updated?

Would authoritative digital datasets (available on national geoportals) be more useful to more people today?



# Thank you!



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**bordermap** consulting

Geographical intelligence for international  
boundary-making and dispute resolution