

# OVER THE BORDERLINE

UNCERTAINTY OVER THE EXACT LOCATIONS OF COUNTRIES' BORDERS CAN SLOW ECONOMIC GROWTH AND EVEN CAUSE WARS. CHRISTOPHE DEKEYNE AND CYRIL ROMIEU EXPLAIN HOW GEOGRAPHIC INFORMATION, BOTH OLD AND NEW, CAN BE USED TO SETTLE DISPUTES AND ENSURE STABILITY

The sovereignty of a state and its stability depend partly on the knowledge and careful control of its borders. The demarcation, mapping and setting down of its borders therefore has a considerable impact, avoiding the existence of 'grey areas', in which application of the sovereignty's national laws can pose problems, and giving state authorities, including customs and the police, the means to ensure that regulations are respected and so protect their country's interests and resources.

Even if the issue of borders seems a simple one in most countries, there are still many places around the world with unresolved border issues, a problem that affects the question of sovereignty over territories and can lead to conflict. The overriding problem, however, is that no reliable means exists to solve this stalemate. Only one thing is certain: geographical information is indispensable for all border projects.

Governments that wish to settle disputes over borders encounter many difficulties, all associated with border tracing:

- There are often different interpretations of the texts describing borderlines.
- Searching for documents related to borderlines is difficult, as these are usually in the archives of former colonisers and were not taken

back to their colonies at the time of independence. For example, more than 50,000 old maps from many different countries, as well as old documents relating to borders, are stored in the IGN map library in France. However, these are all available for consultation.

- Borderlines often don't exist or are impossible to find, as they are hidden by vegetation or have sunk into the ground. This was the case for the border between the Democratic Republic of Congo and the Republic of the Congo, where existing border demarcation was very sparse.
  - No recent mapping has been carried out in the territories in question.
- Over and above the technical issues, there is the question of raising funds for demarcation projects. This can be problematic, despite the presence of strategic natural resources in cross-border areas worth far more than the cost of demarcating the territory.

The existence of these resources also makes finding solutions to border problems all the more difficult, and many logging and mining companies often refuse to work on their concessions until the issue of protection is dealt with. Funding bodies must take into account the conflicts or tension that a lack of clearly marked borders can create and their impact on local populations.





Border work for Saudi Arabia/Qatar – clockwise from top left: Geodetic control survey for the demarcation of borders (IGN FI: 1996/2000 and 2007-2010 © D Bordon/IGN); construction of a boundary marker (IGN FI: 1996/2000 and 2007-2010 © J-C Poyard/IGN); position of the new border markers on the border map (IGN FI: 2010-2011); and intermediary boundary marker (IGN FI: 1996/2000 and 2007-2010 © C Romieu/IGNFI)

## Using geographical information in border negotiations

### Project file preparation

Here, the aim is to find all the existing maps and documents (treaties). These will then need to be reworked and adjusted to render them transmittable to and understandable by non-experts, once very precise interpretation work has been carried out.

Old maps at a scale of 1:200,000 often exist and partial coverage of zones at 1:50,000 are sometimes available, as well as photographic coverage and other non-cartographic documents relating to borders. The preparatory work consists of transcribing the descriptions from treaties as closely as possible on the old maps – most of the descriptions use physical elements, such as lines of division, water courses, pathways and trail lines.

New images, either satellite or aerial photos, must be obtained to analyse these border problems and it is also important to carry out field visits. The images and cartographic images found must be made geographically coherent, and map coordinates are transformed into GPS

coordinates, which can be used during field visits to areas with questionable borderlines. The objective of these visits is to check, for example, that the line of water division corresponds to the usual behaviour of local populations, that the water courses have not moved or to find the trace of an old pathway.

### Negotiation

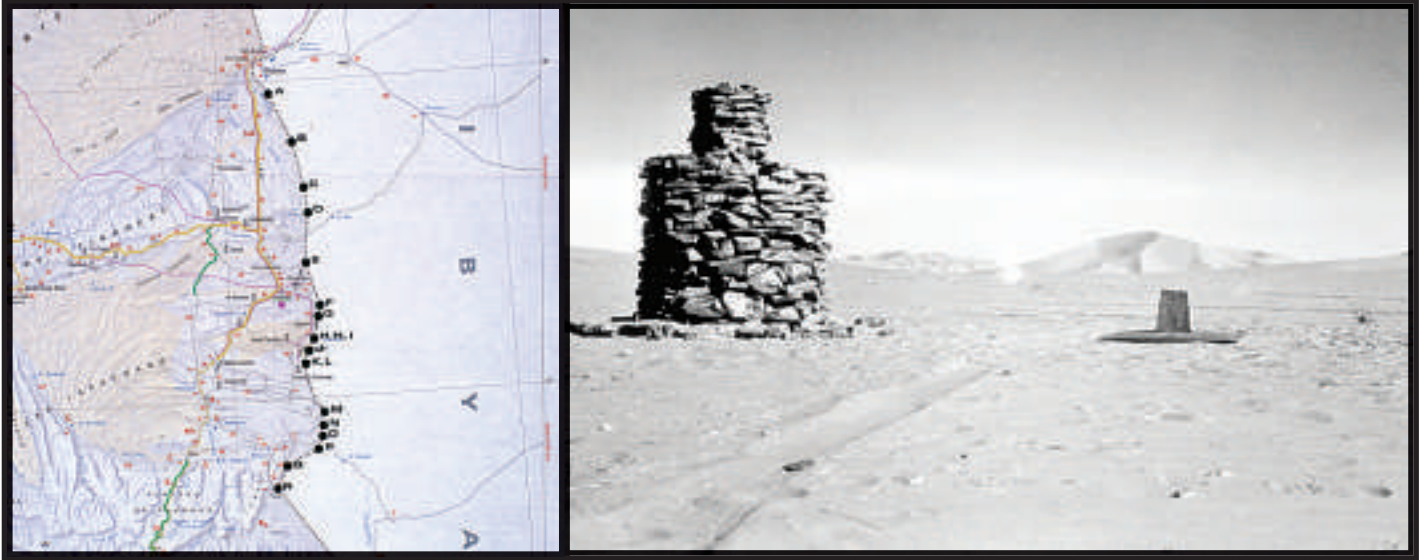
During negotiations on border issues, the cartographic documents created must be unambiguous. This implies carrying out simulations of the various scenarios that have been imagined and creating preparatory documents for the negotiations.

Geographical data is obviously a great asset in negotiations, as it provides neutral and up-to-date information on which or with which the results of negotiations can be transcribed. This information might be accurate imagery of the contentious areas – the beds of water courses might have moved, for example – general mapping used as a basis for documents included in the agreement, or possibly a list of coordinates of border points in a GPS-style international system.

### Demarcation

Once negotiations are over, the new borderline is demarcated and mapped. Demarcation consists of marking out the borderlines in the field if possible and can be determined in various ways:

- If the border is determined by coordinates (straight lines for the Sahara borders, the Saudi Arabia/Qatar border), the reference geodesic network must be created or renewed, and the border points then set. The physical representation of the border, border posts, can then be built and their coordinates accurately calculated.
- If the border is determined by maps or texts, new images of the area must be acquired. The creation of a reference geodesic system then enables old maps to be readjusted and integrated into an international reference. The two countries concerned can then agree on the positions of border posts using the texts drafted during negotiations. Border posts can then be built and the coordinates of each post recorded. These will create the definitive borderline.



Demarcation of the border between Algeria and Libya between 1957 and 1958 (©IGN)

### Documentation

Mapping territories at different scales ensures that the border will remain in place over time. The first stage is general mapping to a scale between 1:200,000 and 1:1,000,000; this is necessary to obtain an overview of the border and the areas where the border is defined by a river the course of which does not change.

More detailed mapping will then be carried out. Generally, this will be at a scale of 1:50,000 in areas where it is necessary to be able to draw the position of borderlines within their nearby environment, such as inhabited areas, roads and water courses with changing beds. However, in areas with high levels of detail or those that are disputable (for example, a borderline running through a village), a scale of up to 1:10,000 may be chosen. Decisions must be made case by case in order to use the best scale for the target area.

### Things to bear in mind

There are a few issues that require special attention before starting a new border project.

### Reference systems

Old maps often use unknown reference systems, each state often having its own reference system. These are not usually GPS-compatible or coherent with available imagery. It is therefore necessary to create a common reference system for all documents that is independent of each state, using an ITRF (International Terrestrial Reference Frame) or AFREF (African Geodetic Reference Frame), which is presently being implemented in Africa. It is also necessary to obtain field measurements to pass from national to international systems and for all countries to make use of all the documents available.

### Field visits

Fieldwork imposes many constraints. It mobilises a large amount of technical (vehicles, living quarters, possibly civil engineering) and human resources. Issues

affecting access to sites (for example, road networks and climatic constraints) often impede progress.

However, fieldwork must not be neglected. It is important for demarcation, the calculation of imagery control points and the transformation of coordinate systems for maps, as well as for 'toponymics': variations in village names, place names or rivers are a great source of information when determining border points, and are indispensable for understanding old treaties and drawing up new maps.

### Essential imagery

The main issue with images is cost and the choice of good imagery for a border project is often delicate. It is therefore important to find the best compromise between the quality and cost of images. The needs are different for each part of the project:

- During preparation, metric resolution is the preferred option with THR images.
- During negotiations, each party will provide the documents in its possession.
- During demarcation and documentation, images with a resolution of 5m (Rapid Eye, SPOT) are sufficient. Very high resolution images (stereoscopic, metric or sub-metric), aerial photos at a resolution of 20cm, or LiDAR-type readings are used for contentious areas. For the final mapping, SPOT or Rapid Eye imagery will be used for maps to a scale of 1:200,000; SPOT 6/7, Terra Sar X or Tandem X for medium-scale mapping at a scale from 1:50,000 to 1:200,000; very high resolution images with stereoscopic capacity (such as from WorldView, GeoEye and Pléiades) for medium and large scales (>1:50,000); and airborne imagery (digital camera, LiDAR) for very large scale (>1:10 000).

The quality of images must be studied in detail. It is necessary to ensure the availability of images: do images already exist in the archives or will they need to be acquired? If images do exist, is the quality sufficient? If not,



Boundary demarcation between France and Italy © IGN

could substitute images (old images with a lower resolution, specific aerial acquisition) be used for areas that are not covered?

### Perspectives

A border project requires numerous resources (financial, technical, human). To minimise the cost of a project and make it viable, it is important to capitalise on what already exists.

However, expenditure for these projects should be considered as a form of investment – the data acquired can be used for other national geographical data infrastructure projects. This ensures national projects are both coherent and less expensive.

## EXPENDITURE FOR THESE PROJECTS SHOULD BE CONSIDERED AS A FORM OF INVESTMENT

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In search of the lowest astronomical tide at Pointe Indienne in the Republic of Congo © Pierre Mouscardes

# SHIP SHAPE

FOLLOWING ON FROM THEIR ARTICLE LAST ISSUE ON DETERMINING THE EXACT LOCATIONS OF COUNTRIES' BORDERS, CHRISTOPHE DEKEYNE AND CYRIL ROMIEU EXPLAIN HOW HYDROGRAPHERS AROUND THE WORLD – PARTICULARLY FRENCH HYDROGRAPHERS – DETERMINE COUNTRIES' MARITIME BOUNDARIES

The 1982 United Nations Convention of the Law of the Sea (UNCLOS), endorsed by 166 countries and the EU, aims to regulate the sovereign rights of coastal states on their territorial seas, continental shelves, bed and subsoil endowed with living and mineral resources, and the air space above. Under UNCLOS, the nautical chart is the legal medium by which national maritime boundaries are published worldwide. This speaks volume for the responsibility assumed by those hydrographers tasked with carrying out the surveys and producing the official charts.

French hydrographers are doubly concerned. Heirs of the world's most senior hydrographic office, established almost 300 years ago when their country was still a superpower, they are responsible for charting the second exclusive economic zone (EEZ) of the planet and assist their diplomats in negotiating with the 32 countries or so with which France shares maritime boundaries – an unenviable record they could do without, so complex is the knowledge required to reach an agreement between neighbouring countries, which must encompass geographical constraints, geophysical realities, historical practices, geodesy, astronomical tides, nautical charting, safety and navigation considerations, and finally jurisprudence.

The origins from which are measured the breadth of the well-known strips of water defined by the UNCLOS convention (that is the Territorial Sea, the Contiguous Zone, the EEZ and the 350 miles constraint line) are

the 'baselines'. Defined as the limit of the low water mark, a baseline is not easy to determine. First, it can only be observed once every 18.6 years, which is the precession period of the lunar nodes. Even then, it is often very poorly depicted on nautical charts.

For example, the baseline of the Gulf of Guinea has only been determined once – 170 years ago. To update it, one must conduct further surveys with the techniques of the 21st century and set off in quest of the elusive lowest astronomical tide. The baseline is now obtained using satellite images, topographic measurements of beaches' slopes and – water turbidity permitting – satellite-derived bathymetry.

Coastal states are required to deposit with the Secretary-General of the United Nations through diplomatic channels the list of coordinates and nautical charts depicting the baselines and outer limits of the maritime areas they claim.

Once plotted on official nautical charts, this geographic information becomes the basic ingredient required by lawyers and diplomats to settle their differences – in the best of cases, by gracious agreement, in the worst, by a laborious arbitration made by an international tribunal that surveyors must continue supplying with supporting evidence.

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