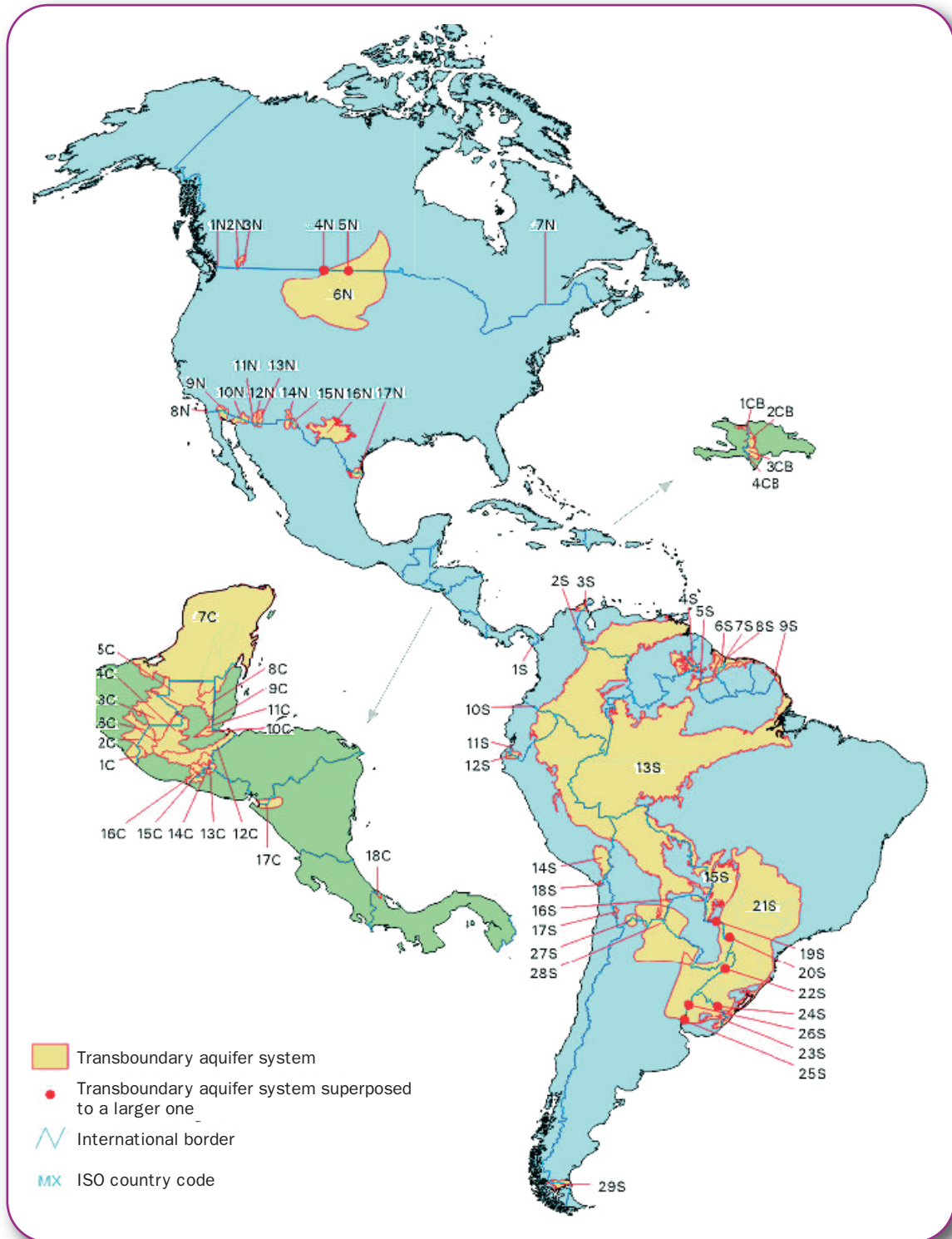


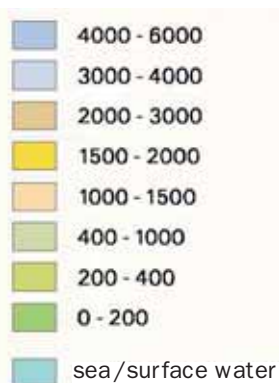
# AMERICAS

## TRANSBOUNDARY AQUIFERS INVENTORY

### OVERVIEW



Elevation (in metres above mean sea level)  
(for aquifer location maps and aquifer maps)



Type of boundary  
(for individual aquifer maps)

Class Description	Degree of reliability of the boundary		
	Reliable	Approximate	Inferred
1 Boundary of a 'true aquifer' (subsurface body with rather good capacity for storing and transmitting groundwater).			
2 Boundary of a hydrological basin that includes aquifer zones.			
3 Boundary of a geological formation (or its outcrops) in which aquifer zones are found.			
4 Unclassified transboundary subsurface unit, possibly belonging to one of the previous classes.			

Source: UNESCO/OAS, 2007.

# AMERICAS

## TRANSBOUNDARY AQUIFERS INVENTORY

### OVERVIEW

North America		
1N	Abbotsford-Sumas	Canada-USA
2N	Okanagan-Osoyoos	
3N	Grand Forks	
4N	Poplar	
5N	Estevan	
6N	Northern Great Plains	
7N	Châteauguay	
8N	San Diego-Tijuana	Mexico-USA
9N	Cuenca Baja del Río Colorado	
10N	Sonoyta-Pápagos	
11N	Nogales	
12N	Santa Cruz	
13N	San Pedro	
14N	Conejos Médanos-Bolsón de la Mesilla	
15N	Bolsón del Hueco-Valle de Juárez	
16N	Edwards -Trinity-El Burro	
17N	Cuenca Baja del Río Bravo/Grande	

Central America		
1C	Soconusco-Suchiate/Coatán	Guatemala-Mexico
2C	Chicomuselo-Cuilco/Selegua	
3C	Ocosingo-Usumacinta-Pocóm-Ixcán	
4C	Márquez de Comillas-Chixoy/Xaclbal	
5C	Boca del Cerro-San Pedro	
6C	Trinitaria-Nentón	
7C	Península de Yucatán-Candelaria-Hondo	Guatemala-Mexico-Belize
8C	Mopán-Belice	Guatemala-Belize
9C	Pusila-Moho	
10C	Sarstún	
11C	Temash	Guatemala-Honduras
12C	Motagua	
13C	Chiquimula-Copán Ruinas	Guatemala-Honduras-El Salvador
14C	Esquipulas-Ocotepeque-Citalá	
15C	Ostúa-Metapán	El Salvador-Guatemala
16C	Río Paz	
17C	Estero Real-Río Negro	Honduras-Nicaragua
18C	Sixaola	Costa Rica-Panama
28S	Yrendá-Toba -Tarijeño	Argentina-Bolivia-Paraguay
29S	El Cóndor-Cañadón del Cóndor	Argentina-Chile

### Caribbean

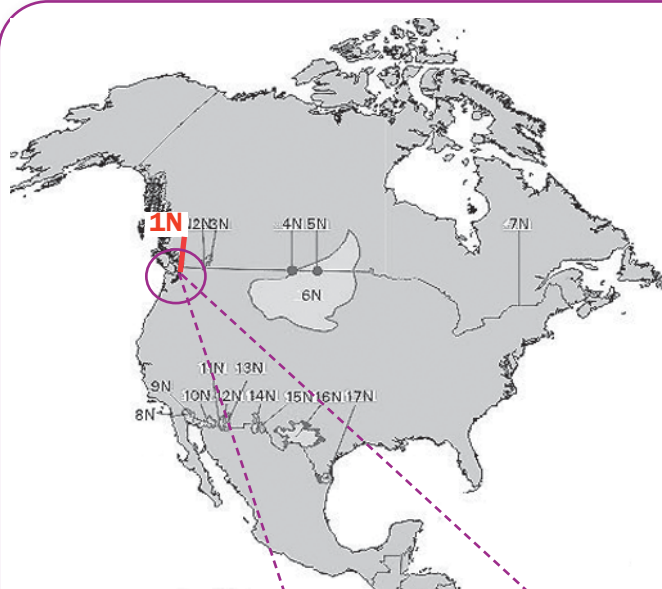
1CB	Masacre	Haití-Rep. Dominicana
2CB	Artibonito	
3CB	Los Lagos	
4CB	Pedernales	

### South America

1S	Choco-Darién	Colombia-Panama
2S	Táchira-Pamplonita	Colombia-Venezuela
3S	La Guajira	
4S	Grupo Roraima	Brazil-Guyana-Venezuela
5S	Boa Vista-Serra do Tucano-North Savanna	Brazil-Guyana
6S	Zanderij	Guyana-Suriname
7S	Coesewijne	
8S	A-Sand/B-Sand	
9S	Costeiro	Brazil-Guayana Francesa
10S	Tulcán-Ipiales	Colombia-Ecuador
11S	Zarumilla	Ecuador-Peru
12S	Puyango-Tumbes-Catamayo - Chira	
13S	Amazonas	Bolivia-Brazil-Colombia-Ecuador-Peru-Venezuela
14S	Titicaca	Bolivia-Peru
15S	Pantanal	Bolivia-Brazil-Paraguay
16S	Agua Dulce	Bolivia-Paraguay
17S	Ollagüe-Pastos Grandes	Bolivia-Chile
18S	Concordia/Escritos-Caplina	Chile-Peru
19S	Aquidauana-Aquidabán	Brazil-Paraguay
20S	Caiuá/Bauru-Acaray	
21S	Guaraní	Argentina-Brazil-Paraguay-Uruguay
22S	Serra Geral	
23S	Litoráneo-Chuy	Brazil-Uruguay
24S	Permo-Carbonífero	
25S	Litoral Cretácico	Argentina-Uruguay
26S	Salto-Salto Chico	
27S	Puneños	Argentina-Bolivia
28S	Yrendá-Toba -Tarijeño	Argentina-Bolivia-Paraguay
29S	El Cóndor-Cañadón del Cóndor	Argentina-Chile

## NORTH AMERICA : Aquifers details

### Abbotsford-Sumas



#### Inter-state instruments

##### ■ Inter-state cooperation:

An international team cooperates in the management of the aquifer, through regular exchange of information and common decision-making.



#### Canada-United States of America

- Extent: 100 km<sup>2</sup>.
- Non confined. Sand and gravel.
- Volume: ~ 3.7 km<sup>3</sup>.
- Provides water supply to 10,000 people in USA and 100,000 in Canada.
- Locally intensively and/or overexploited.
- Vulnerable to contamination.

Lake Kananaski, Canada  
© Morguefile





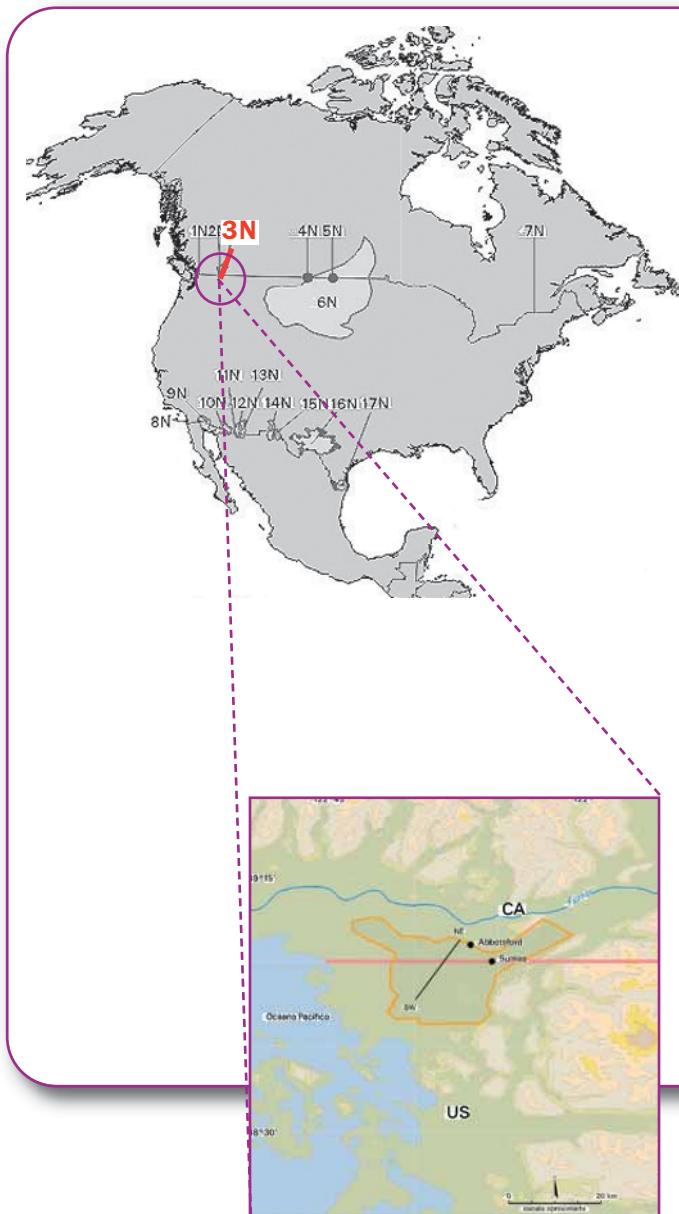
Lake Okanagan, Canada  
© Morguefile



## Okanagan-Osoyoos

### Canada-United States of America

- Extent: 25 km<sup>2</sup>.
- Depth: 100–500 m.
- Multilayered.
- Non consolidated sediments.
- More important use in Canada all year.
- Increase in population due to development of vineyards .



## Grand Forks

### Canada- United States of America

- Extent: 34 km<sup>2</sup>.
- Depth: 50–100 m.
- Alluvial aquifer.
- Non consolidated sediments.
- Voume: 1.7 km<sup>3</sup>.
- Excellent database available.

Lake Okanagan, Canada  
© Morguefile





Lake Waterton, Canada  
© Morguefile

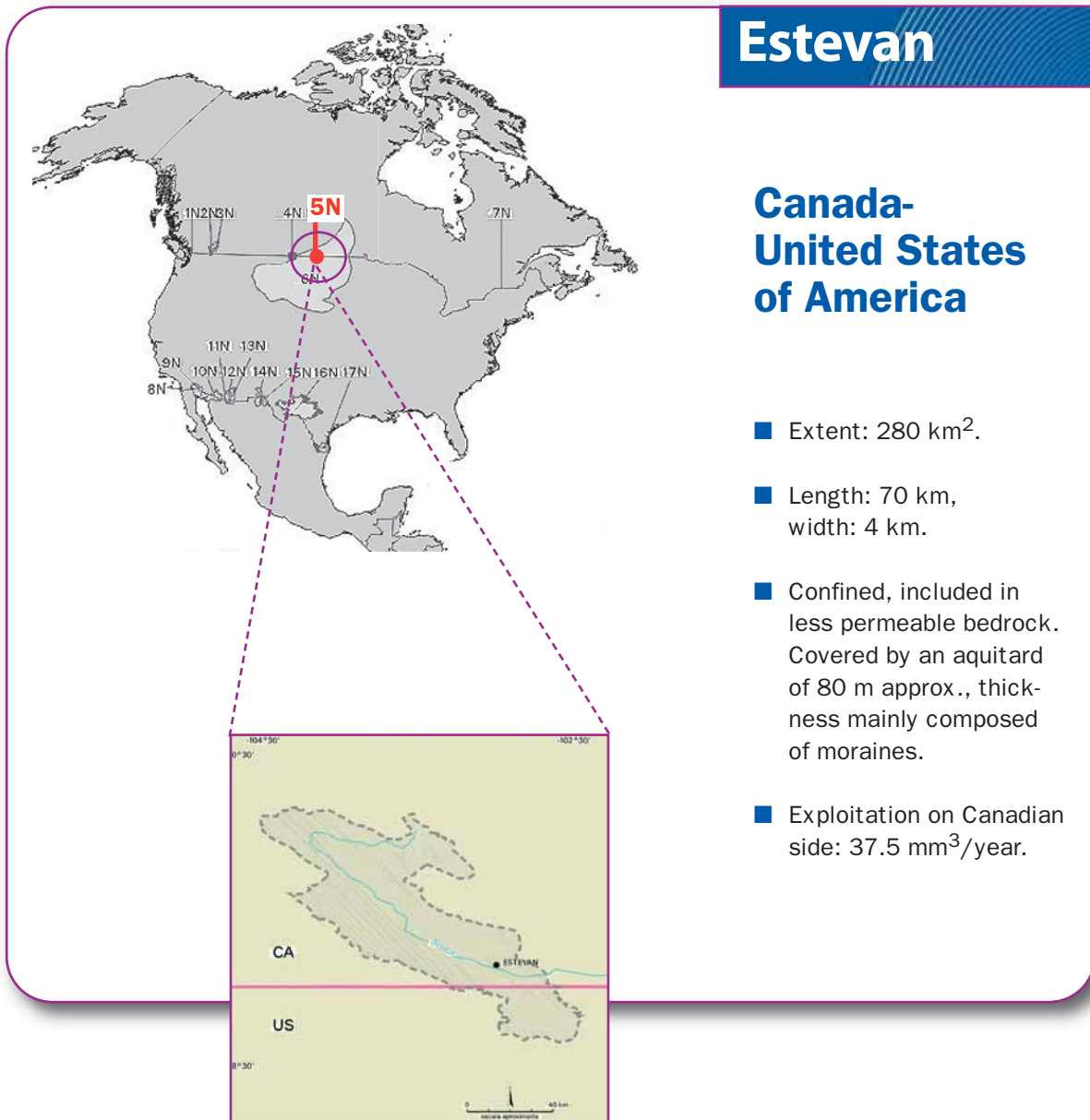
## Poplar

### Canada- United States of America

- Limited information available.
- Extent: more than 10,000 km<sup>2</sup>.

**Inter-state instruments**

- **Inter-state cooperation:**  
A bilateral committee has been established to exchange information on monitoring.

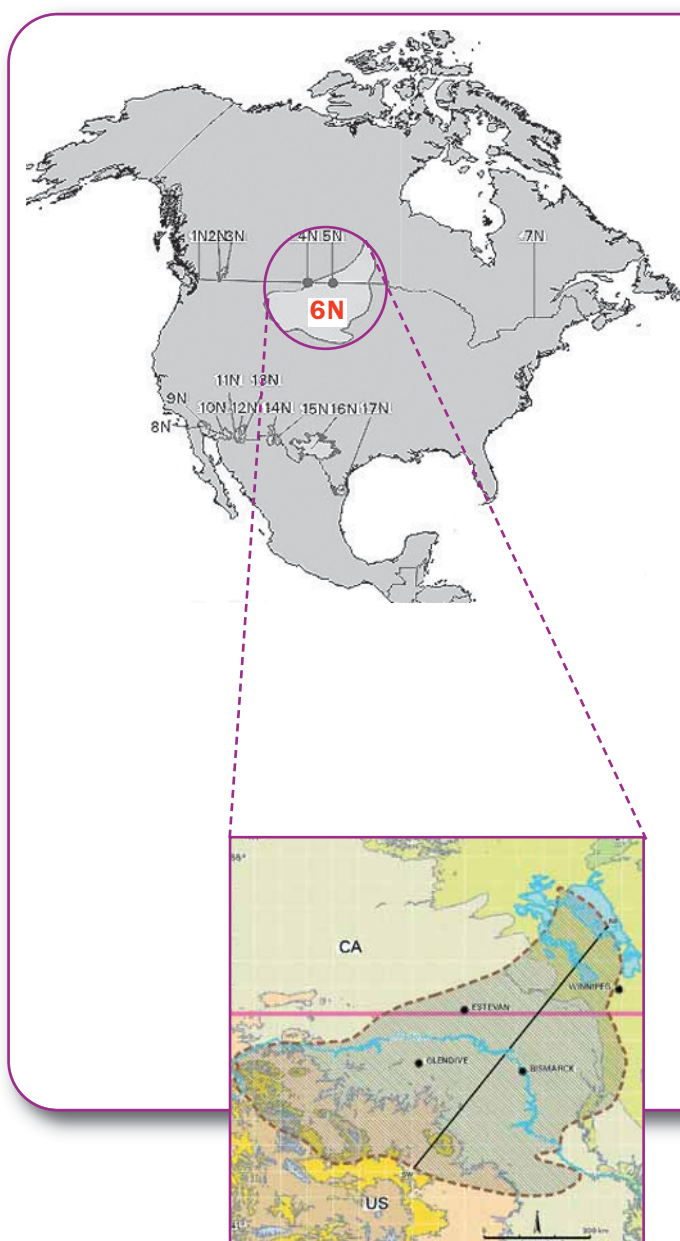


Fort Edmonton Park,  
North Saskatchewan River, Canada  
© SXC/Jeremy Bohn





Glacier National Park, Montana, USA  
© Morguefile



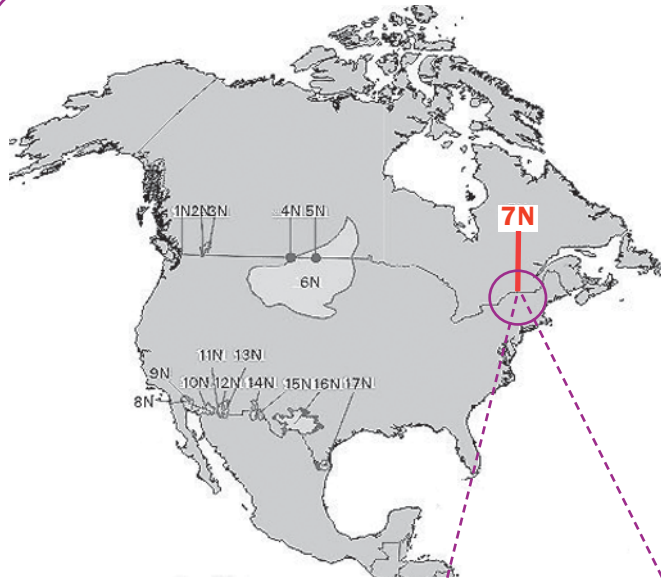
## Northern Great Plains

### Canada-United States of America

- Large, confined aquifer system: more than 500,000 km<sup>2</sup>, 75% in USA.
- System transmissivity: 100 m<sup>2</sup>/d.
- Combined recharge: regional scale in USA, local scale in Canada.

# Châteauguay

## Canada-United States of America



- Extent: 2,500 km<sup>2</sup>.
- Groundwater use: 15 mm<sup>3</sup>/a, on Canadian side only.
- Average thickness: 500 m.
- Important use in Canada with 55% of total area and high demand for all uses.

### Inter-state instruments

- **Inter-state cooperation:** Bilateral cooperation.

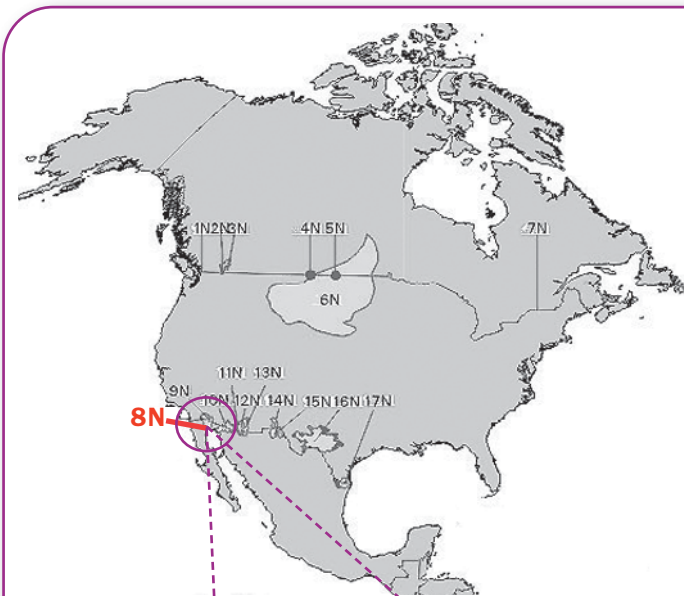


Tremblant, Quebec, Canada  
© SXC





Highway to Tijuana, Mexico  
© SXC

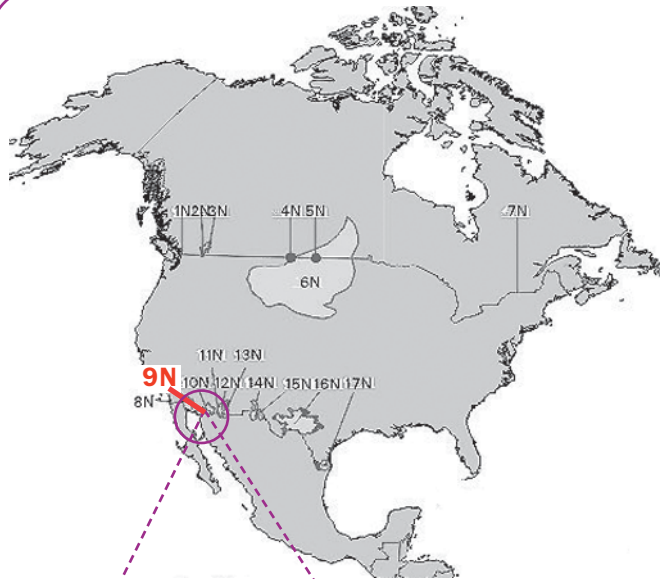


## San Diego-Tijuana

### Mexico-United States of America

- Small extent.
- High water demand in both countries, high exploitation in Mexico.
- Problems: contamination and seawater intrusion.
- Semi-arid climate.





## Cuenca Baja del Río Colorado

### Mexico-United States of America

- Semi-arid climate.
- More important use on Mexican side.
- Problems of spreading contamination due to agricultural practices.
- Aquifer studied in both countries: database and model simulation available.

### Inter-state instruments

- Negotiations within **International Commission of International Boundaries and Water Commission - Comisión Internacional de Límites y Aguas (IBWC-CILA)**.

Lake Mead, Colorado River, USA  
© SXC/Shauvette Babb





San Jose Mountains, Sonora, Mexico  
© Morguefile

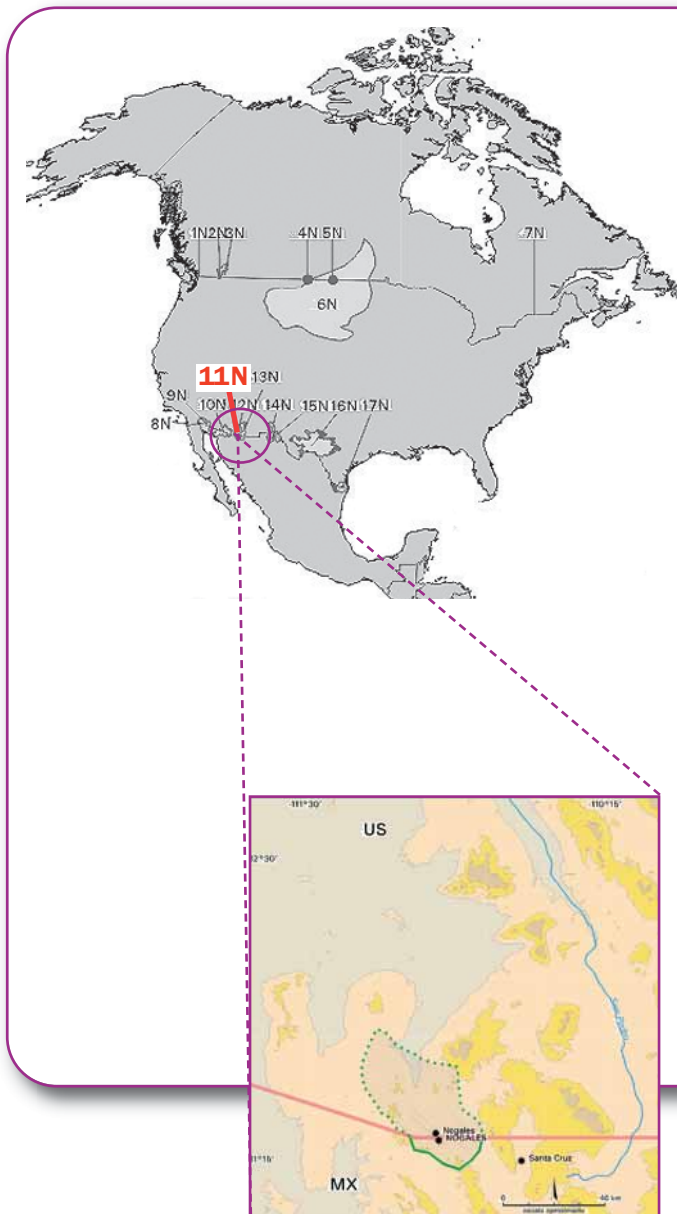


## Sonoyta-Pápagos

### Mexico-United States of America

- Alluvial aquifer.
- Depth: 20 to 200 m.
- Low population density.
- Main use: agriculture in Mexico.
- Brackish water locally.
- Semi-arid climate.





## Nogales

### Mexico-United States of America

- Alluvial materials and fissured rocks.
- Small extent, shallow depth, medium permeability.
- Semi-arid climate.
- Urban and industrial use in both countries.
- Contamination problems.

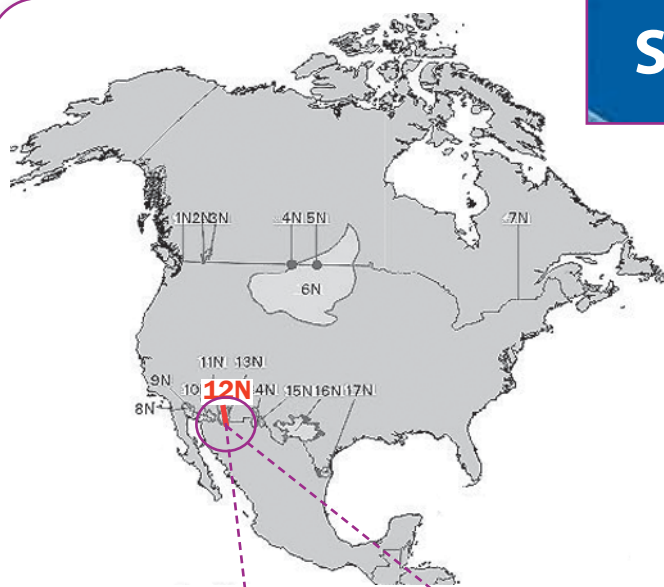
Sierra Vista, Arizona, USA  
© Morguefile





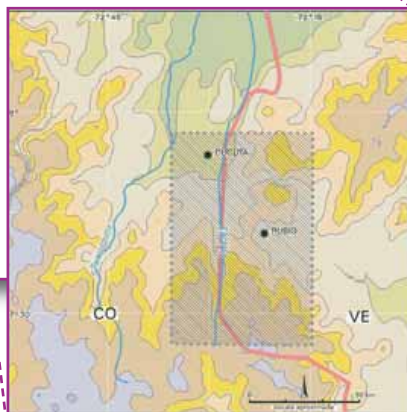
Arizona, USA  
© Morguefile

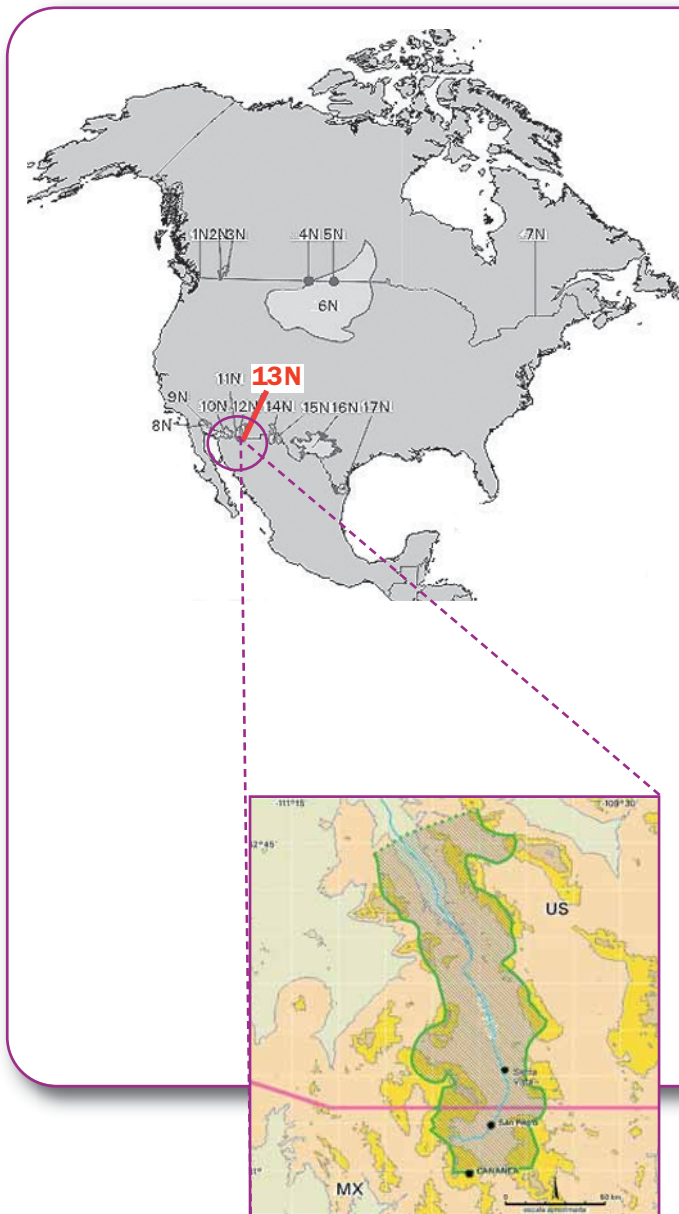
## Santa Cruz



### Mexico-United States of America

- More important use in USA, for agriculture.
- Alluvial materials, conglomerates, fissured volcanic rocks.
- Semi-arid climate.
- Several studies have been carried out.





## San Pedro

### Mexico-United States of America

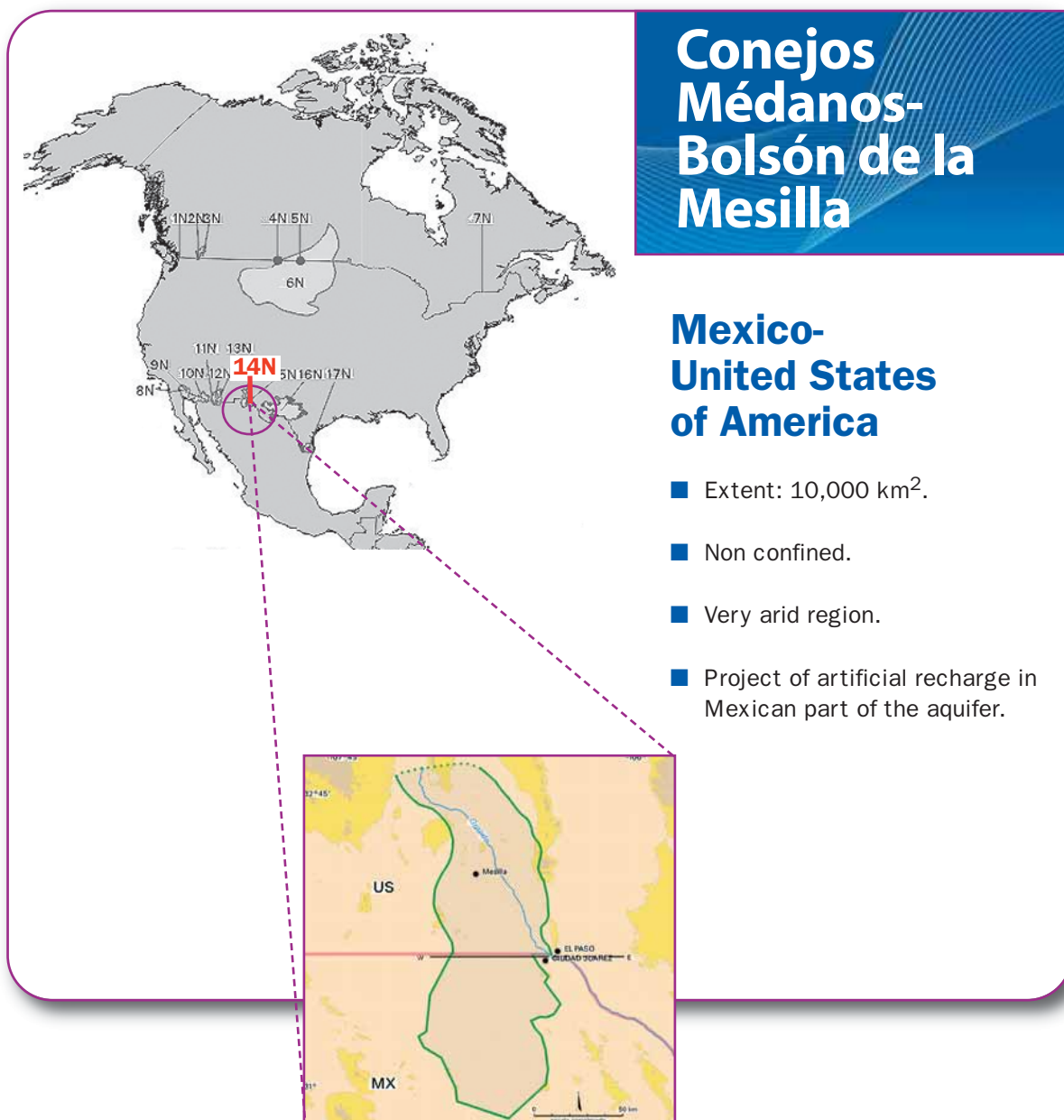
- Semi-arid climate.
- Alluvial materials in valleys and conglomerates in adjacent hills.
- Important for agricultural development of both countries.

San Pedro River, Arizona, USA  
© Morguefile





*Urique River at the base of Urique Canyon, Chihuahua, Mexico*  
© SXC/Rosy Figueroa





## Bolsón del Hueco-Valle de Juárez-Colorado

### Mexico-United States of America

- Extent: 8,000 km<sup>2</sup>.
- Non confined.
- Semi-arid climate.
- Gradual decline in the quality of water.

#### Inter-state instruments

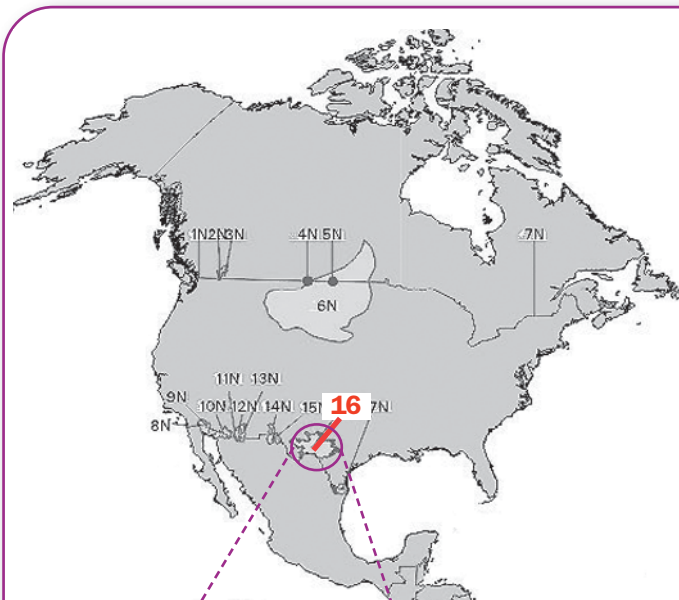
- **Inter-state cooperation:**
  - Exchange of information.
  - Bi-national study aimed at a common formulation of management strategies.

Colorado River, Texas, USA  
© SXC





New Mexico, USA  
© SXC



## Sonoyta-Edwards-Trinity-El Burro

### Mexico-United States of America

- Arid region.
- Extent in USA: 70,000 km<sup>2</sup> (more than 90% of its area).
- Limestone of high secondary permeability.
- Increasing population and industrial development.



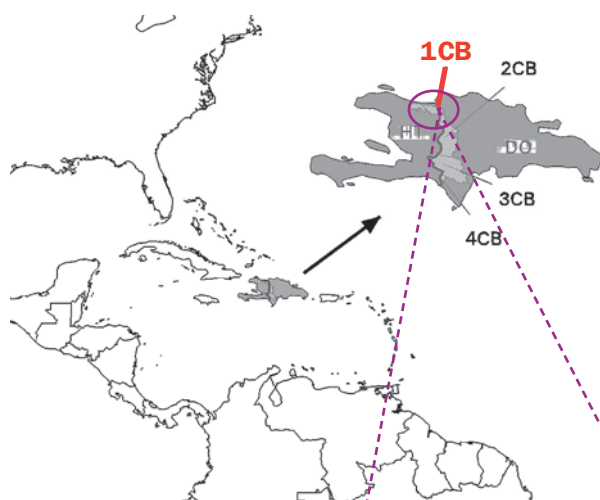
Guadalupe River, Texas  
© Morguefile



## CARIBBEAN: Aquifers details



Saut Mathurine, Haiti  
© SXC



### Masacre

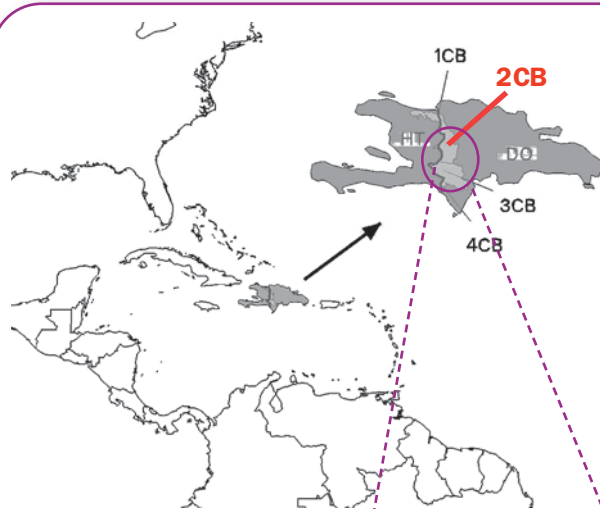
#### Haiti-Dominican Republic

- Extent: 1,200 km<sup>2</sup> on Dominican side and 1,080 km<sup>2</sup> on Haitian side.
- Coastal aquifer. Problems of seawater intrusion.
- Main uses: domestic and agriculture.
- Is the subject of a GEF/UNEP/OAS/UNESCO project focused on its protection and sustainable use.

#### Inter-state instruments

- **Inter-state cooperation:** Agreement of a common vision for the management of their shared groundwater resources.





### Inter-state instruments

- **Inter-state cooperation:** Agreement of a common vision for the management of their shared groundwater resources.



## Artibonito

### Haiti-Dominican Republic

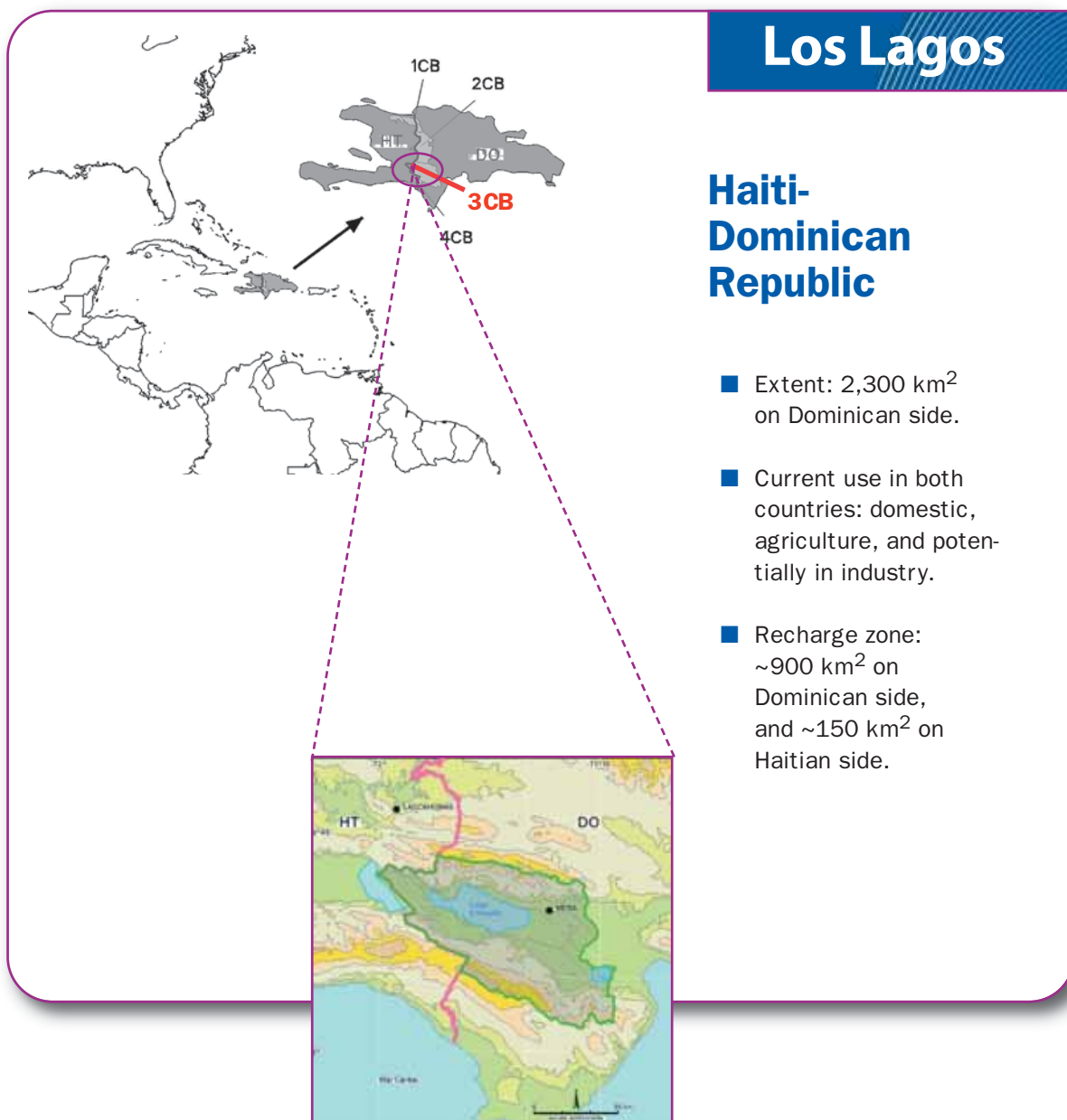
- Extent: 3,000 km<sup>2</sup> in Dominican Rep. and 6,780 km<sup>2</sup> in Haiti.
- As Masacre aquifer, concerned by the GEF/UNEP/OAS/UNESCO project as an example of inter-mountain transboundary aquifer for which the objective is to halt desertification and land degradation and alleviate poverty .

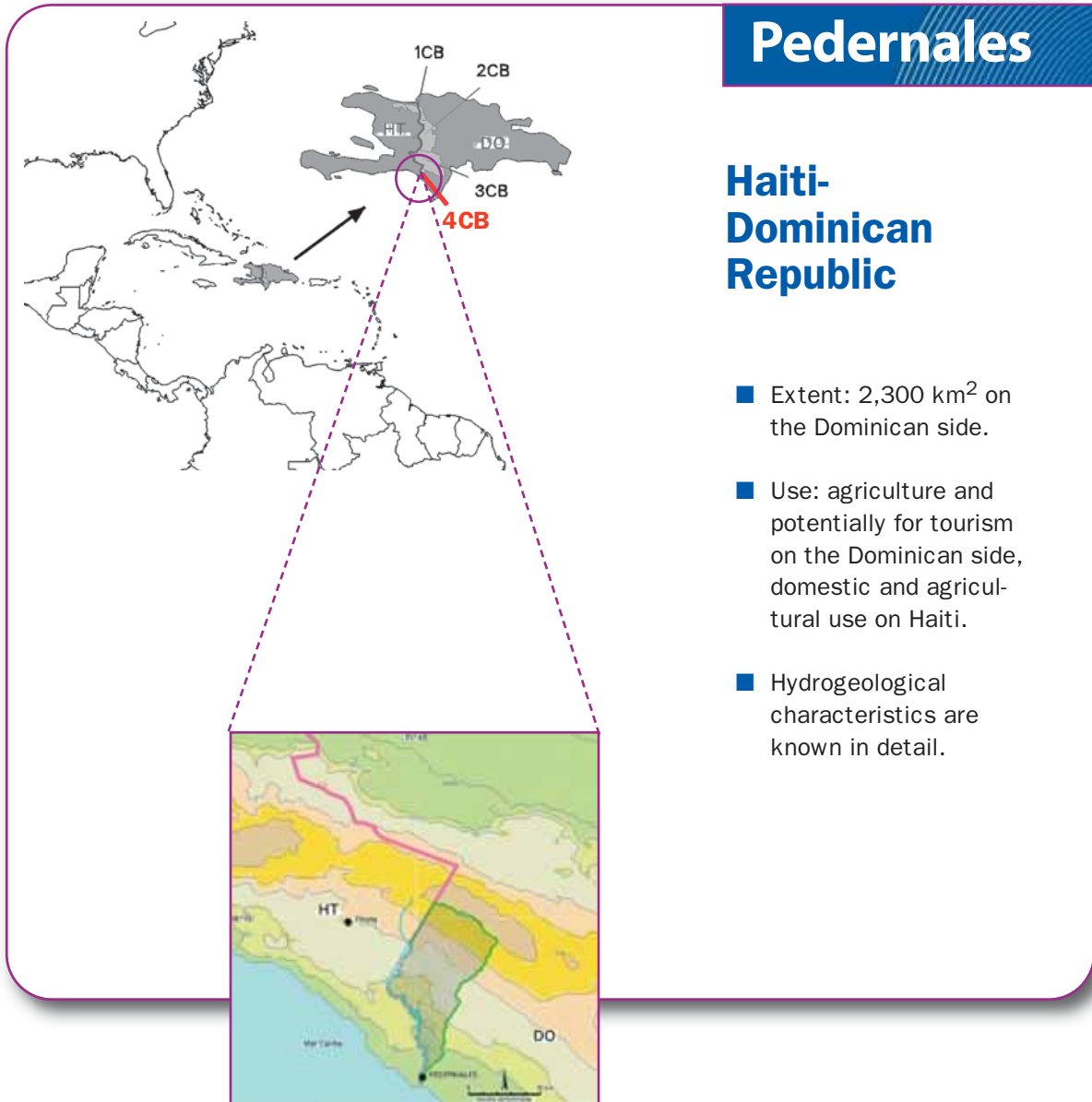
Artibonito Valley  
© UNESCO/Michel Claude





Artibonito Valley  
© UNESCO/Michel Claude





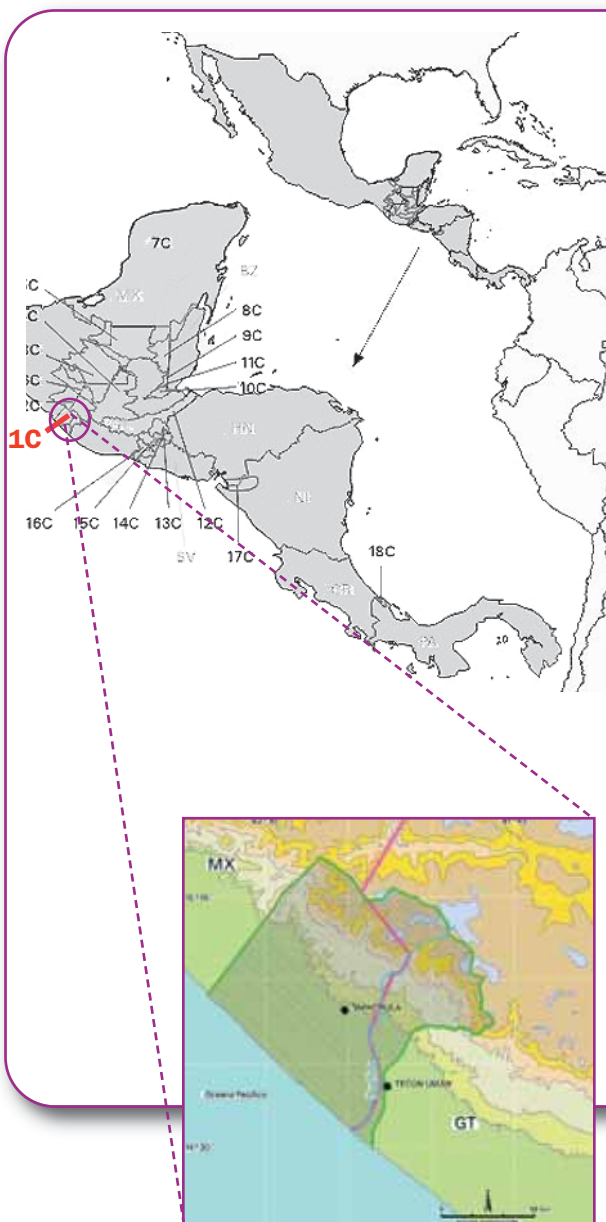
*Artibonito Valley*  
© UNESCO/Michel Claude



## CENTRAL AMERICA: Aquifers details



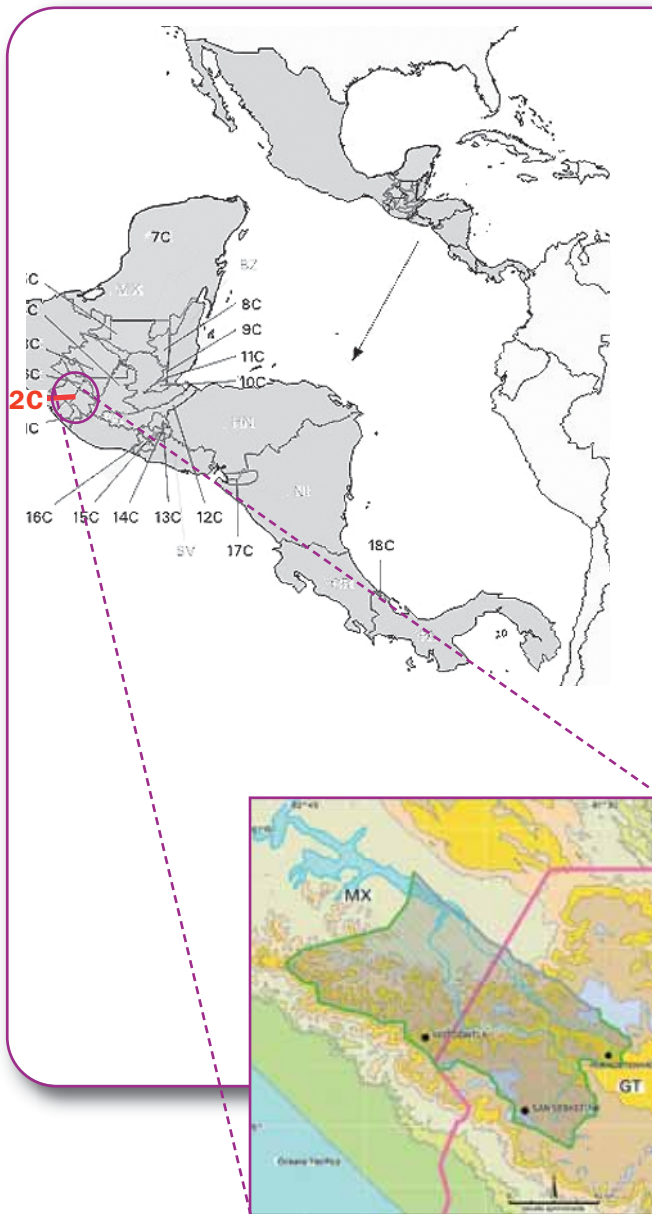
Guatemala Highlands  
© SXC



### Soconusco-Suchiate/Coatán

#### Guatemala-Mexico

- Domestic use concerns 1,500,000 people.
- Used for agriculture to a lesser extent.
- Non confined aquifer.
- Local problems of salinization due to human activities.



## Chicomuselo-Cuilco/Selegua

### Guatemala-Mexico

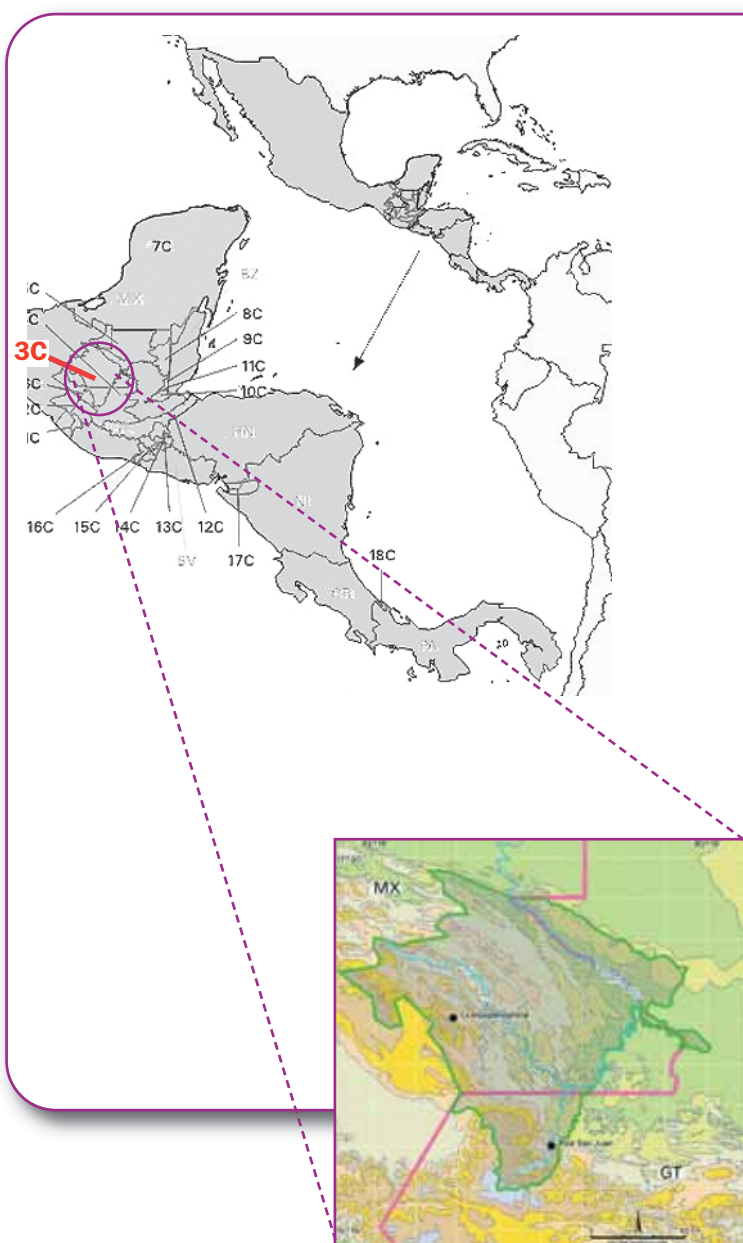
- Dry climate and mountain topography.
- Non confined aquifer with important karst development.
- Hydrogeological information available in both countries.
- Main source of supply for agriculture and domestic uses.
- Contamination due to human activities.

Izabal, Guatemala  
© SXC





Volcano at Lake Atitlan, Guatemala  
© SXC



## Ocosingo- Usumacinta- Pocóm-Ixcán

### Guatemala- Mexico

- Karst aquifer with deep levels combined with complex flow systems.
- Locally, water is not fit for human consumption due to high concentrations of sulfates and carbonates.
- The aquifer supplies water for domestic and agricultural uses to rural population.



## Márquez de Comillas-Chixoy/Xaclbal

### Guatemala-Mexico

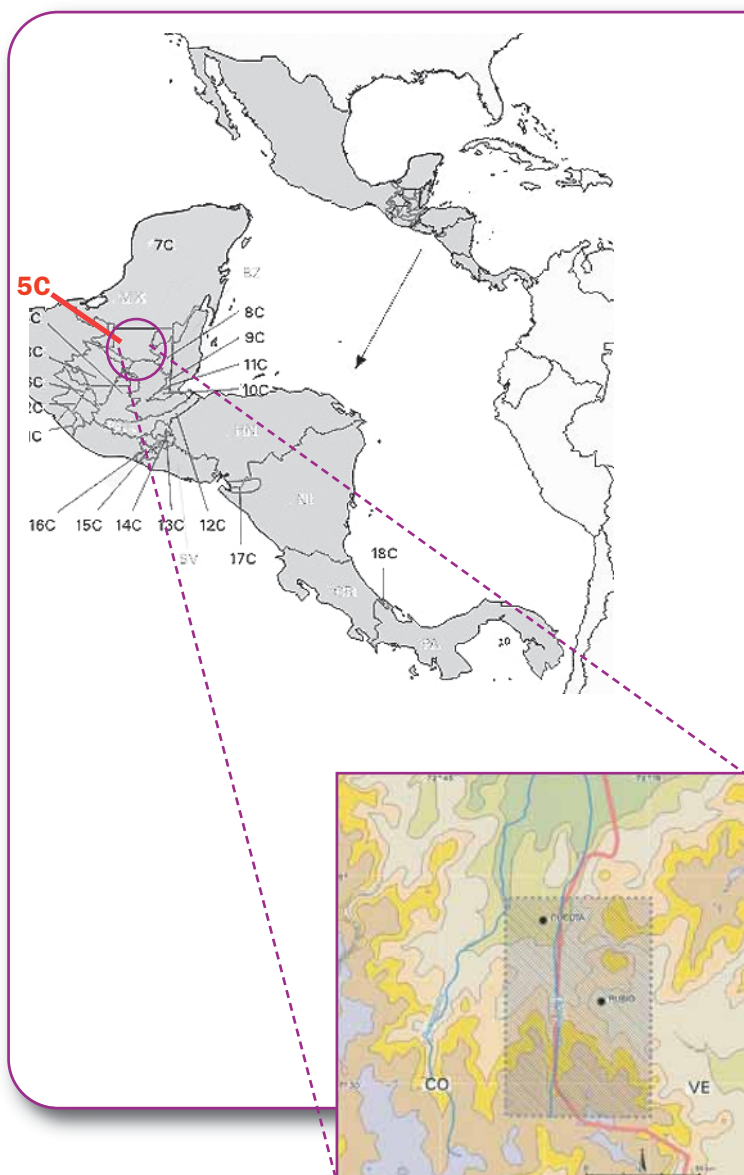
- Supplies water to urban and rural population and, to a lesser extent, for irrigation of small areas.
- Karst aquifer with deep circulation.
- Water flow from Guatemala to Mexico.

River, Mexico  
© SXC





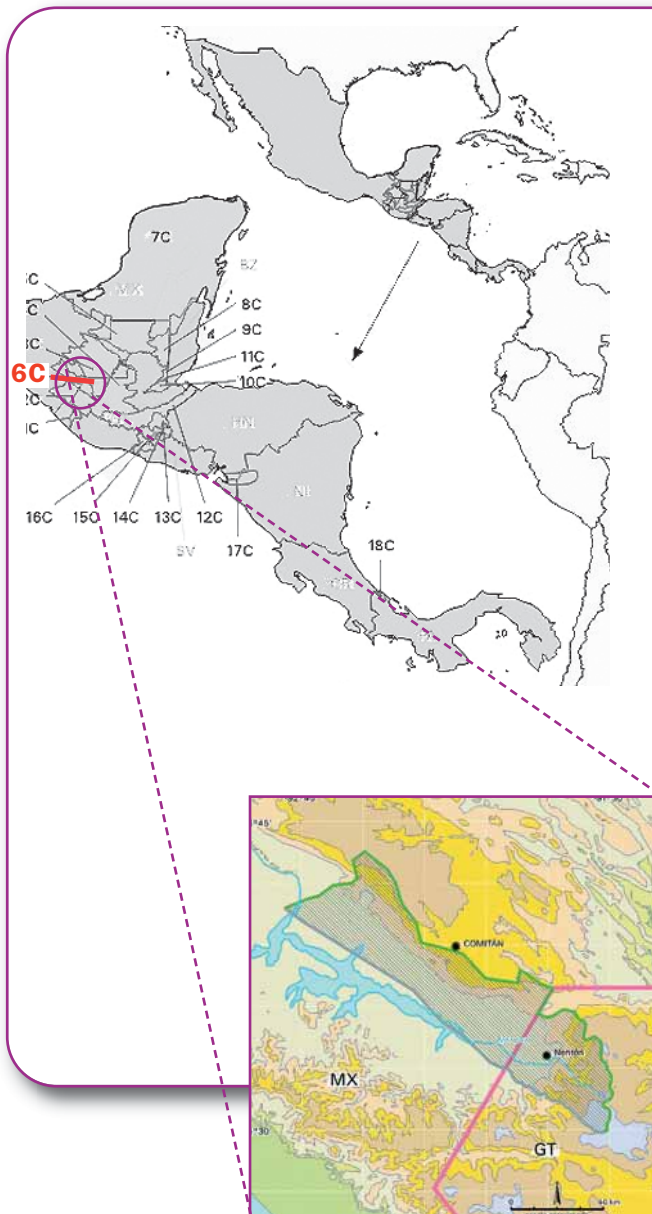
Basalt Prism Canyon, Hidalgo, Mexico  
© Morguefile



## Boca del Cerro-San Pedro

### Guatemala-Mexico

- Karst aquifer with deep circulation.
- Limited exploitation due to high content of sulphates and carbonates.
- The aquifer is being investigated by both countries.



## Trinitaria-Nentón

### Guatemala-Mexico

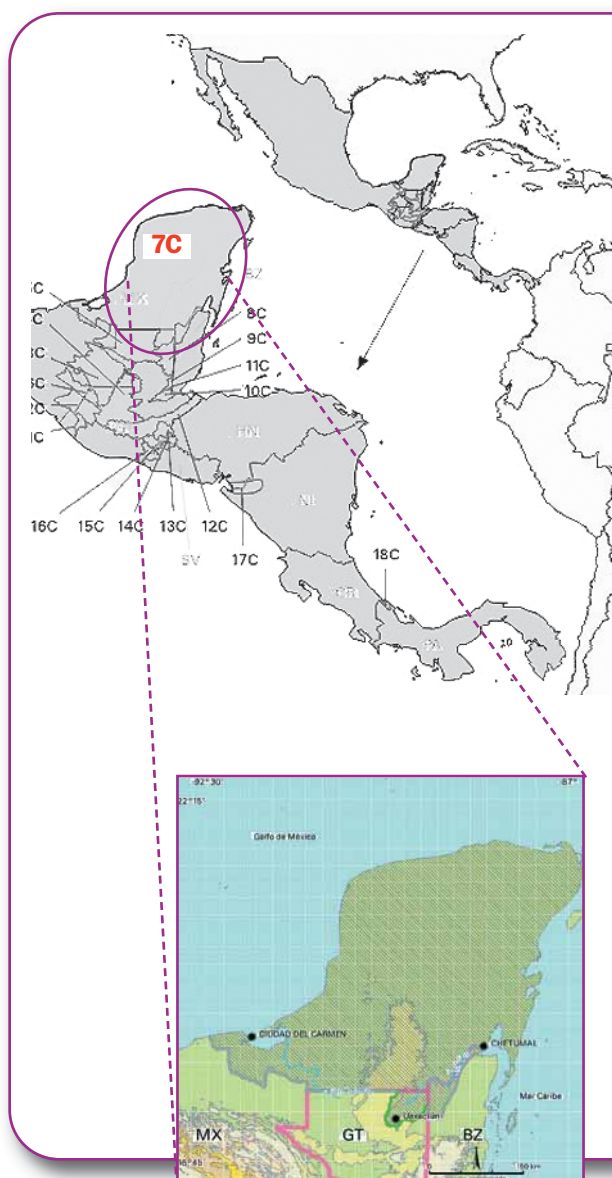
- Main source of supply for rural population.
- Locally contaminated due to waste water discharge.
- Non confined aquifer.
- Water flow from Guatemala to México.
- Studies are on a preliminary phase.

Cusarare Waterfall, Mexico  
© Morguefile





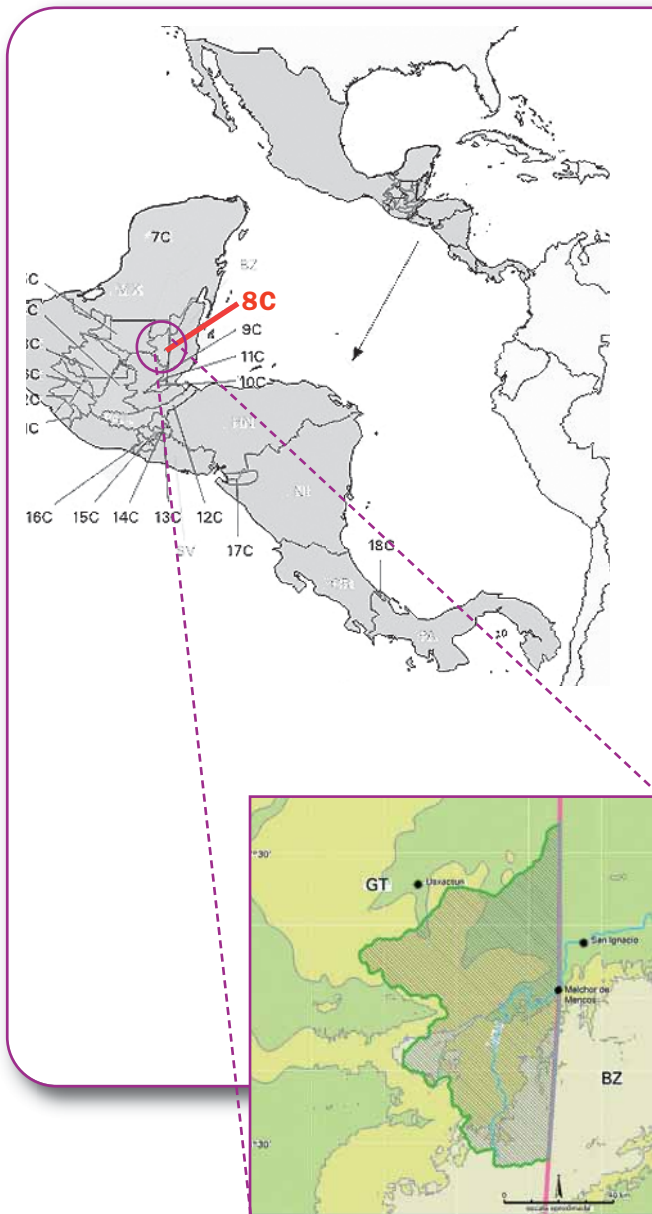
Malinalco landscape, Mexico  
© Morguefile



## Península de Yucatán-Candelaria-Hondo

### Guatemala-Mexico Belize

- Plain region with high infiltration capacity.
- Karst aquifer with high permeability and high vulnerability to anthropogenic contamination.
- Limited hydrogeologic knowledge due to low local development.
- Main source of supply for rural population.



## Mopán-Belize

### Guatemala-Belize

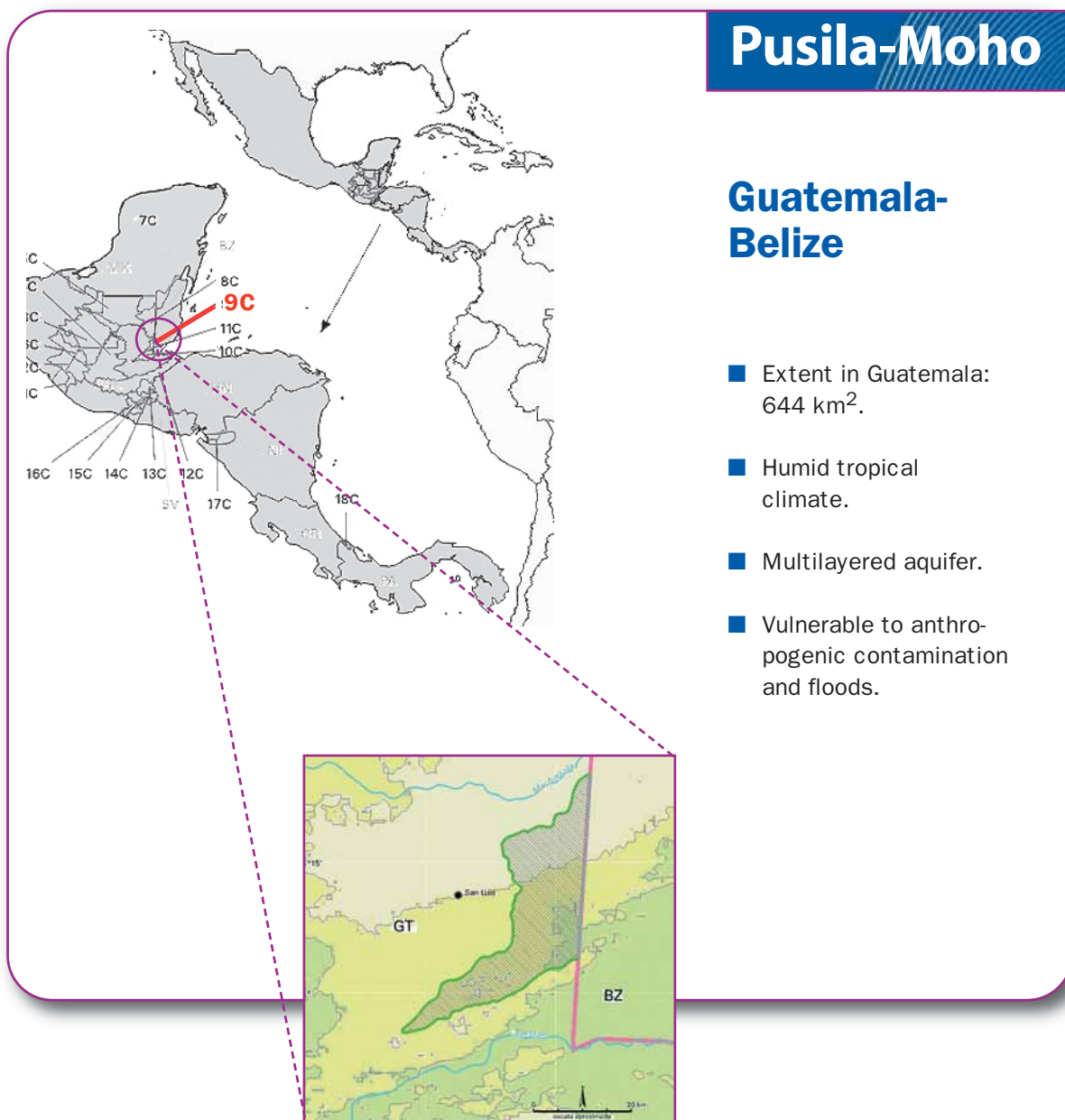
- Principle studies carried out on Guatemala part of aquifer, where it covers almost 5,000 km<sup>2</sup> and where discharge occurs.
- Humid climate.
- High deforestation.
- Vulnerable to anthropogenic contamination.

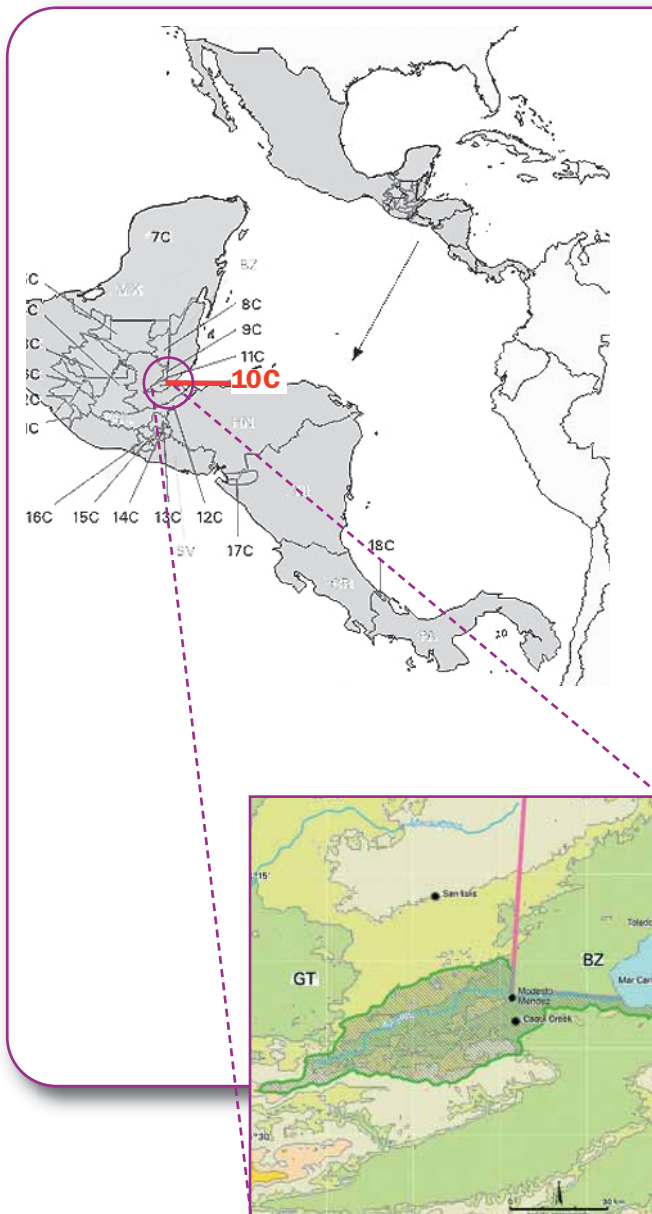
San Cristobal Verapaz, Guatemala  
© UNESCO/Inguat-Samajoa





View from the top of Mayan ruins  
in Lamanai, Belize  
© SXC



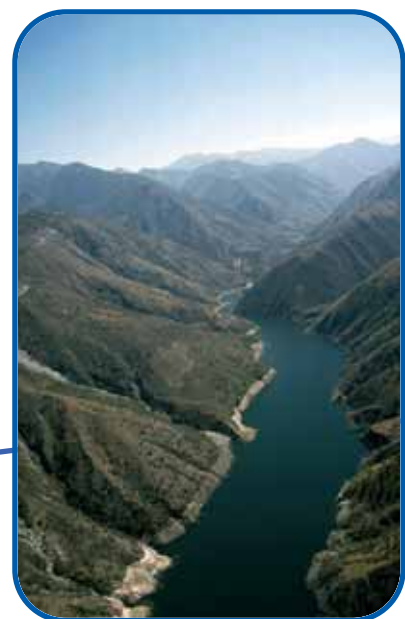


## Sarstún

### Guatemala-Belize

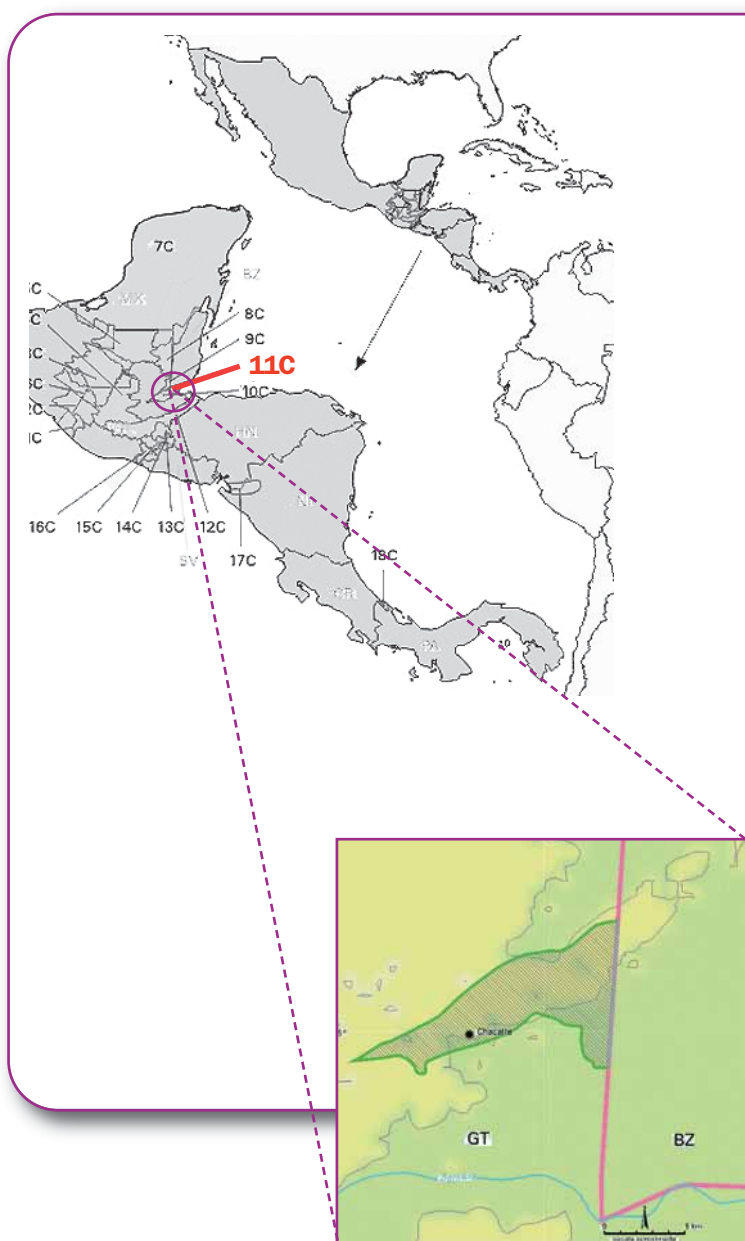
- Extent: 2,109 km<sup>2</sup> in Guatemala.
- Highly deforested zone, but some remaining forest areas.
- Insufficient water supply for human and livestock consumption.

Chixoy Dam, Guatemala  
© UNESCO/Inguat-Samajoa





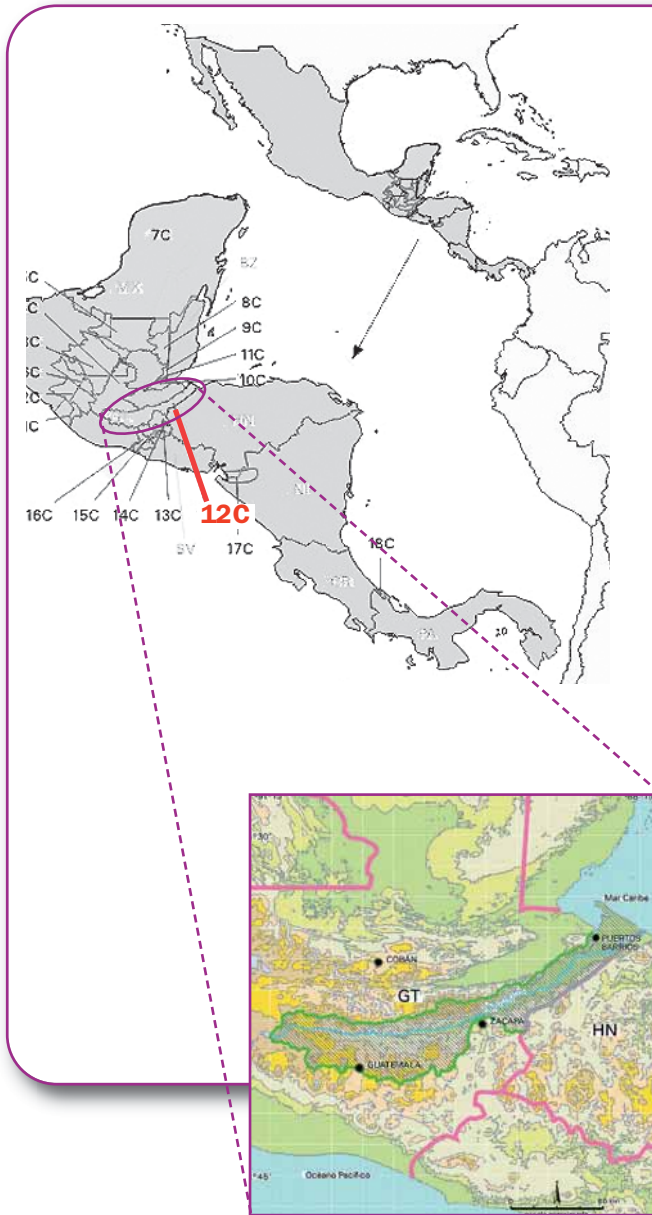
Guatemalan forestland  
© UNESCO/Inguat-Samajoa



## Temash

### Guatemala-Belize

- Extent: 69 km<sup>2</sup> in Guatemala.
- Humid tropical climate.
- Highly deforested zone, but remaining forest areas.
- Vulnerable to anthropogenic contamination and floods.



## Motagua

### Guatemala-Honduras

- Extent: ~2,300 km<sup>2</sup>, flow to the Caribbean Sea.
- Rain: 600–3,000 mm/year.
- Shallow depth.
- Variable transmissivity.

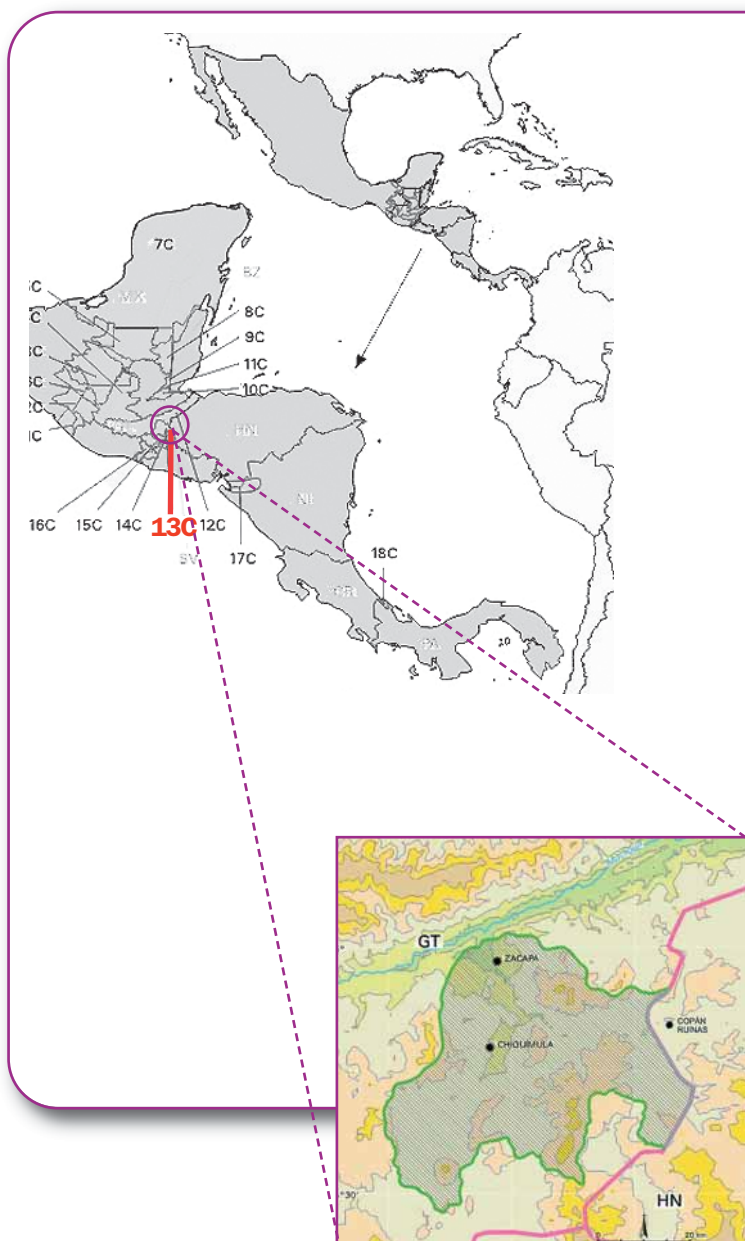
Rio Platano, Honduras  
© UNESCO/Fubomichi Kudo





Copan ruins, Honduras

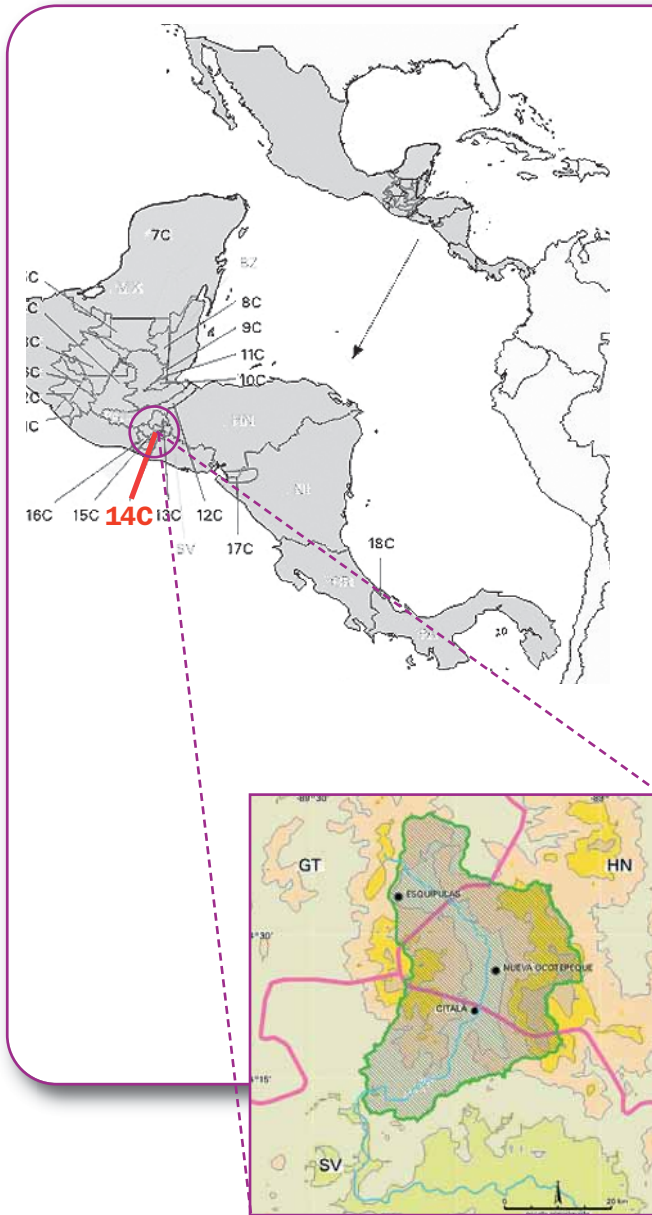
© UNESCO/Guillermo Cobos Hernandez



## Chiquimula-Copán Ruinas

### Guatemala-Honduras

- Region including dry sub-tropical and semi-arid zones.
- Flow from Honduras to Guatemala
- Underpopulated area.
- Subsistence agriculture.
- Water shortage.



## Esquipulas- Ocotepeque- Citalá

### Guatemala- Honduras- El Salvador

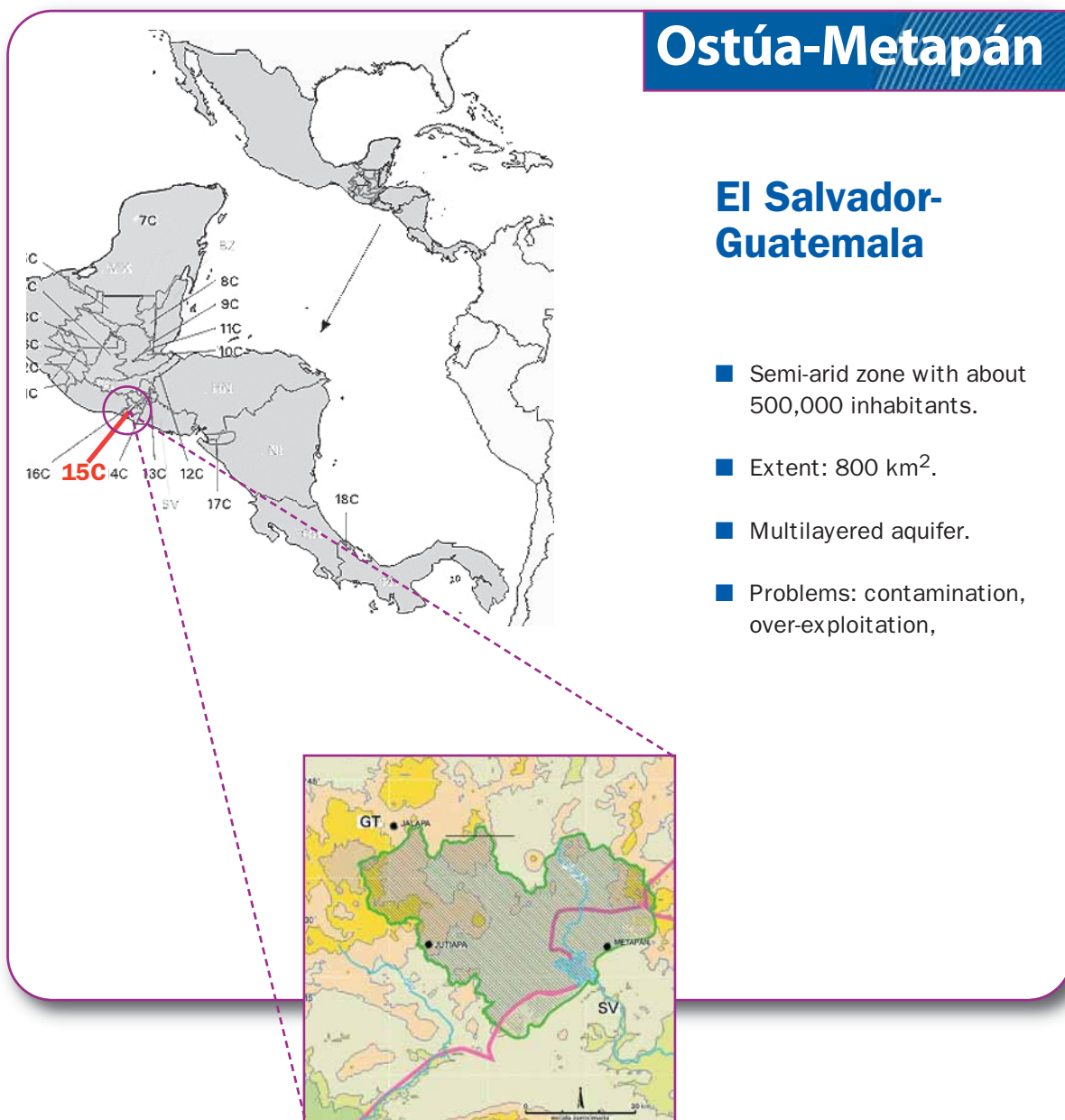
- Aquifer extent: 600 km<sup>2</sup> approx.
- Population of the area: 100,000 inhabitants.
- Humid climate.
- Multilayered and complex aquifer system.
- Problems: contamination, over-exploitation, loss of recharge areas.

Flores, Guatemala  
© SXC





Lake Coatepeque, El Salvador  
© SXC





## Río Paz

### El Salvador-Guatemala

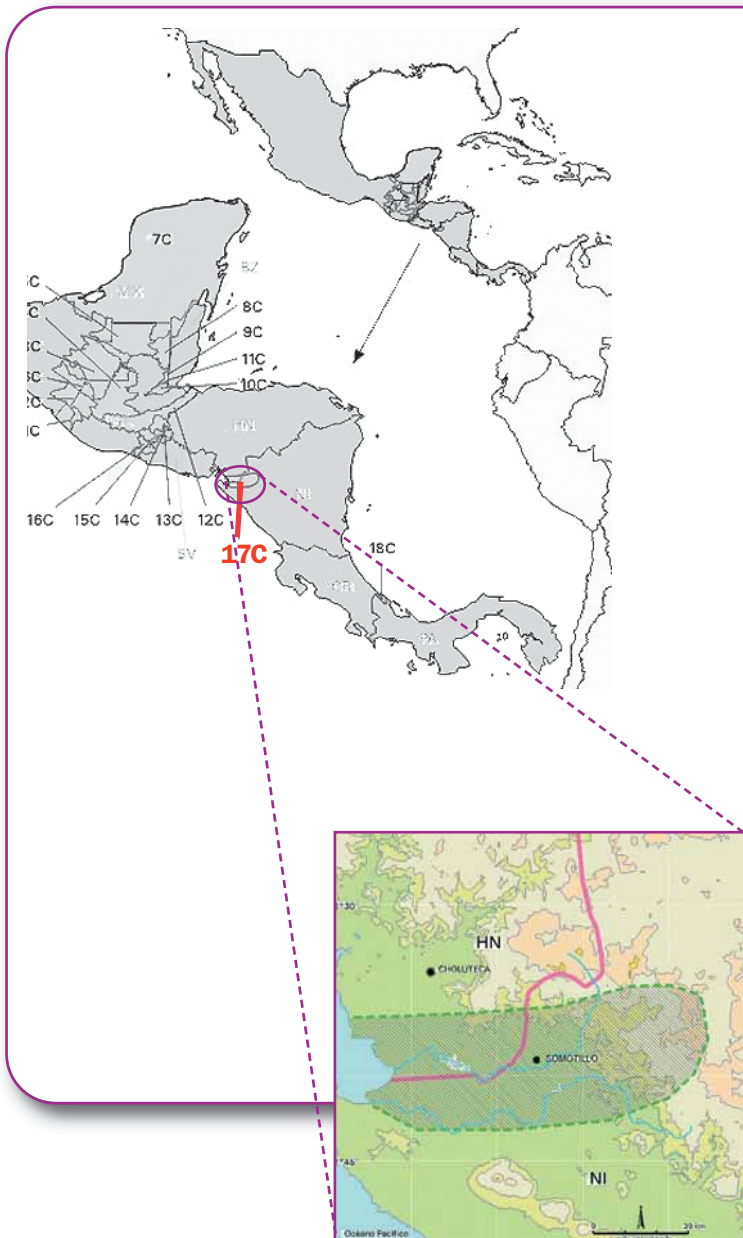
- Geothermal exploitation of deeper aquifer (1,000–1,200 m) .
- Main uses: irrigation and human consumption.
- Shallow aquifers highly exploited.
- Problems: contamination, loss of recharge areas, deforestation.

San José Lake, Guatemala  
© SXC





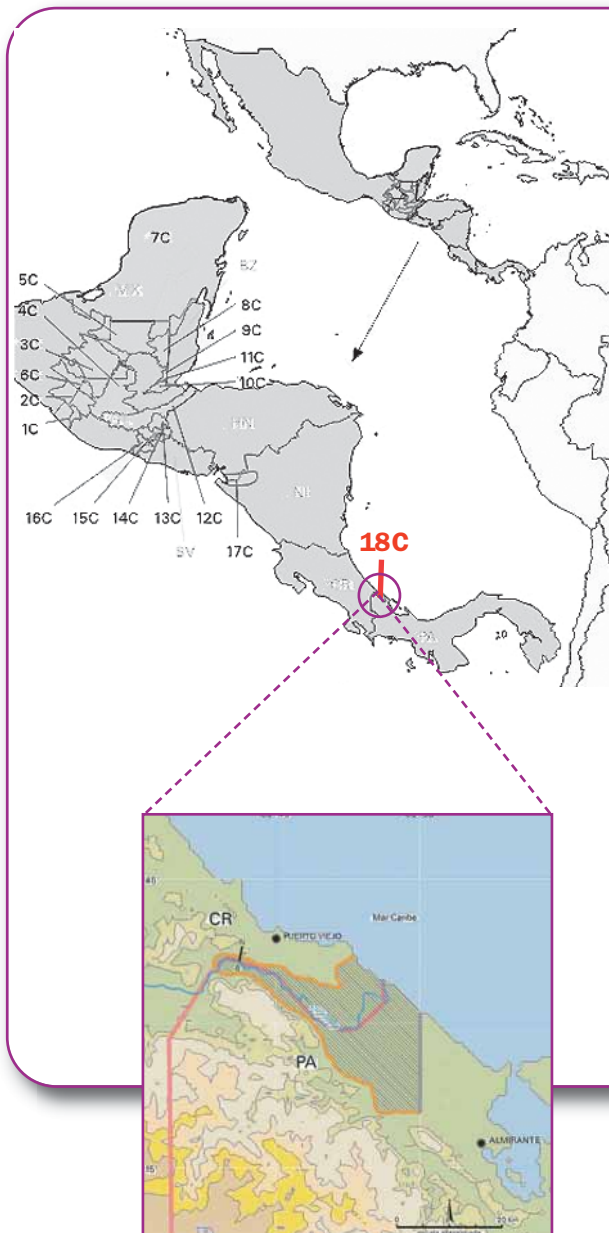
Copan ruins, Honduras  
© SXC



## Estero Real-Río Negro

### Honduras-Nicaragua

- Non confined, depth 5–60 m.
- Vital for human consumption in rural communities.
- Problems: contamination.
- Both countries are implementing integrated management procedures.



## Sixaola

### Costa Rica-Panama

- Main use: agro-industry.
- Future possible uses for human consumption and tourism.
- A strategy concerning the sustainable use of Río Sixaola exists, and both countries are considering projects for an integrated management of the aquifer.

Volcano, Nicaragua  
© SXC/Charle Noe

