



**Comprehensive Exploitation Strategy and
Management for Nandong Underground River
System in Yunnan Province, SW, China**

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The outline

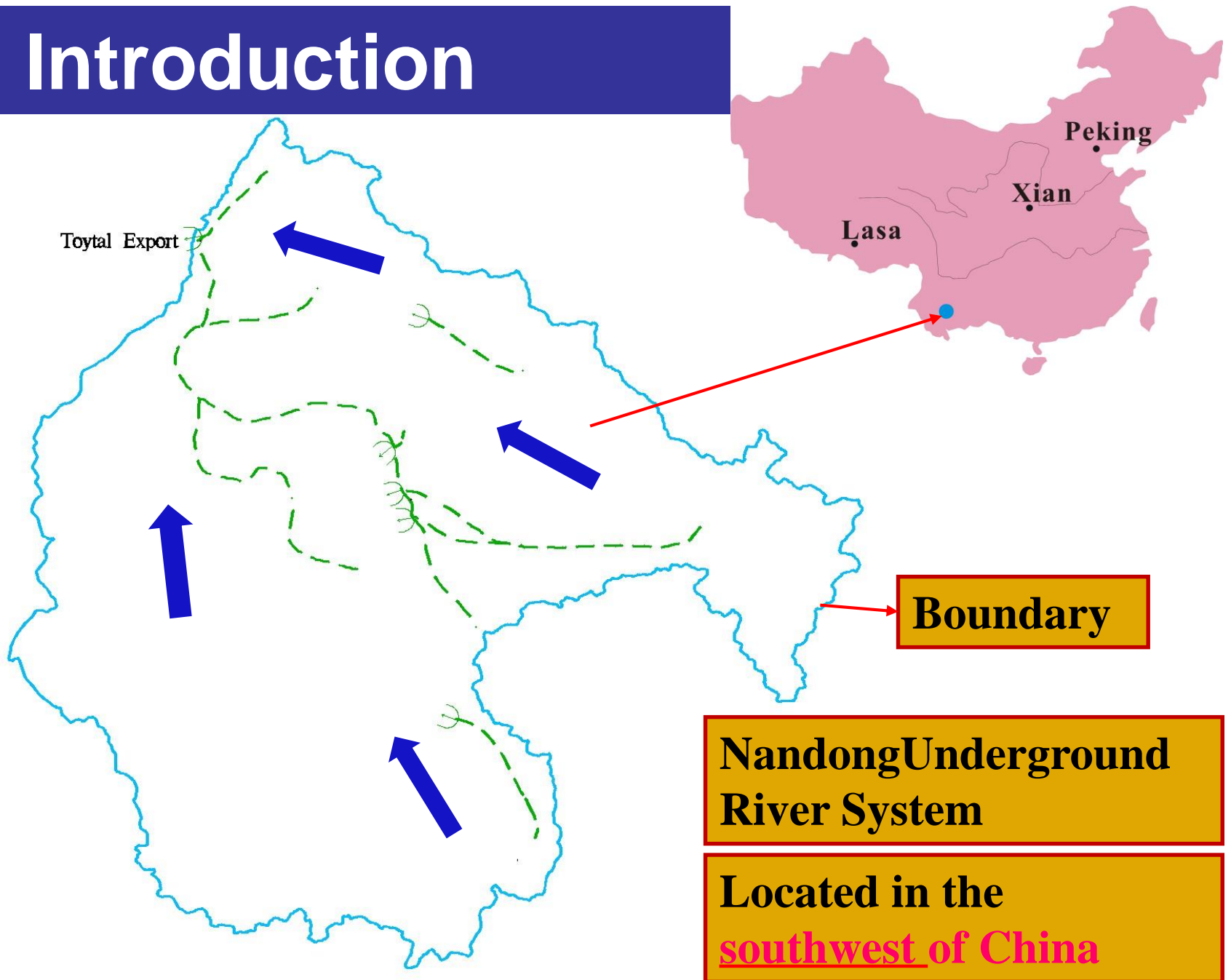
1. Introduction

2. Work and Research

3. Results

4. Strategy

1. Introduction



1. Introduction

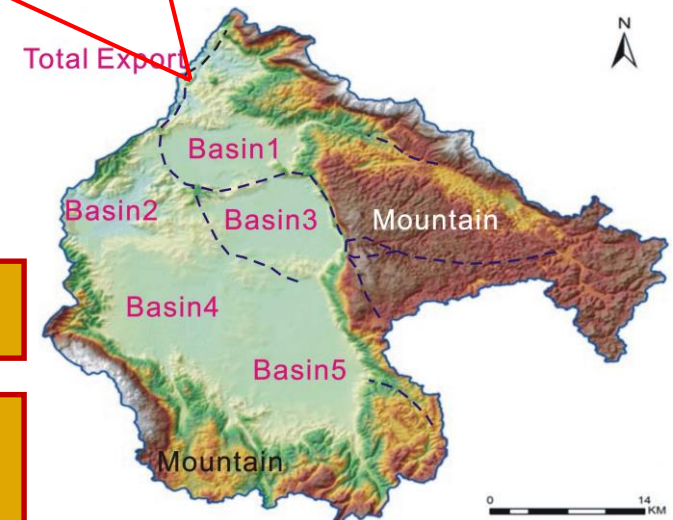


An ultra-large type subterranean river system

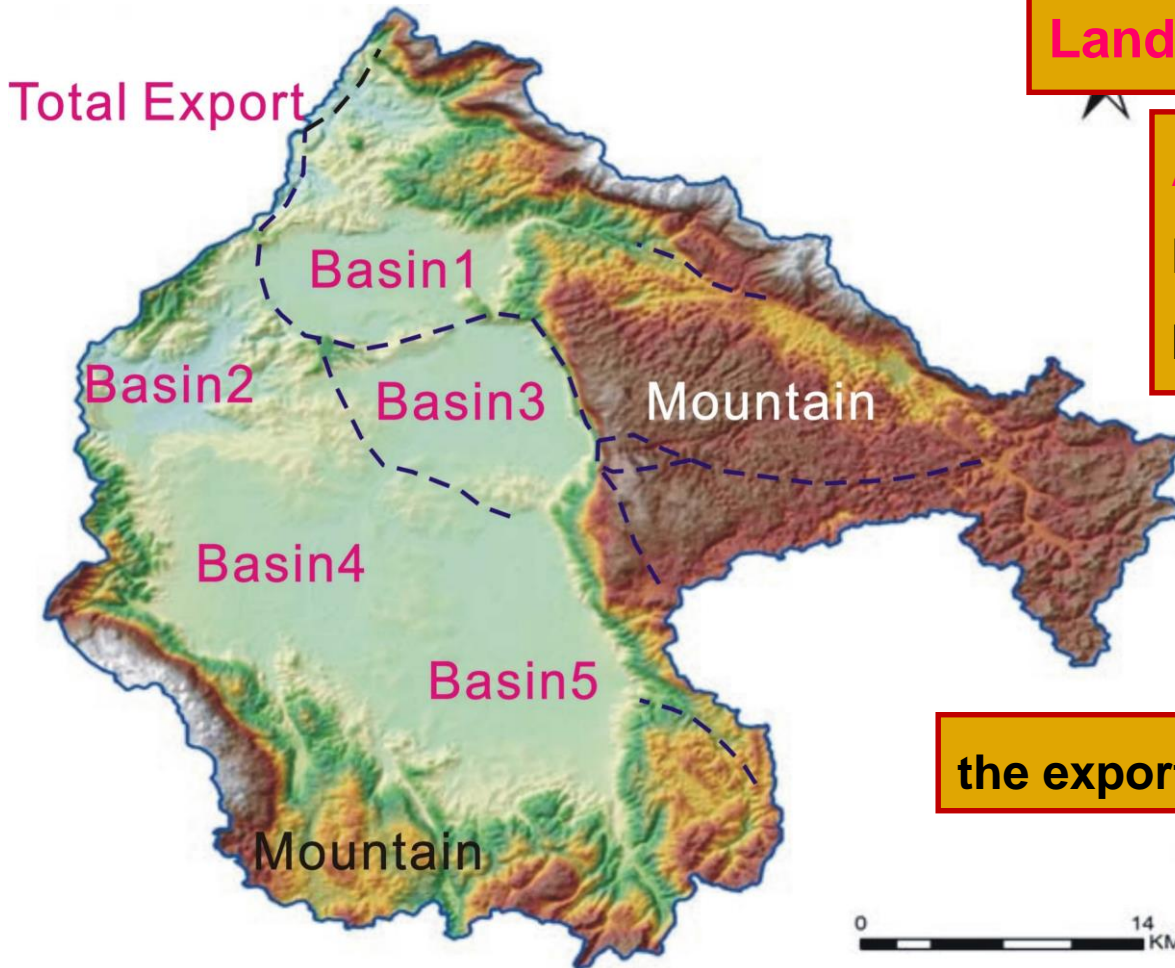
Area: **1684km²**

average quantity of flow: **9.48 m³/s**

Mean annual volume of runoff: **2.98**
hundred million m³/a



1. Introduction



Landform: Basins, Mountains

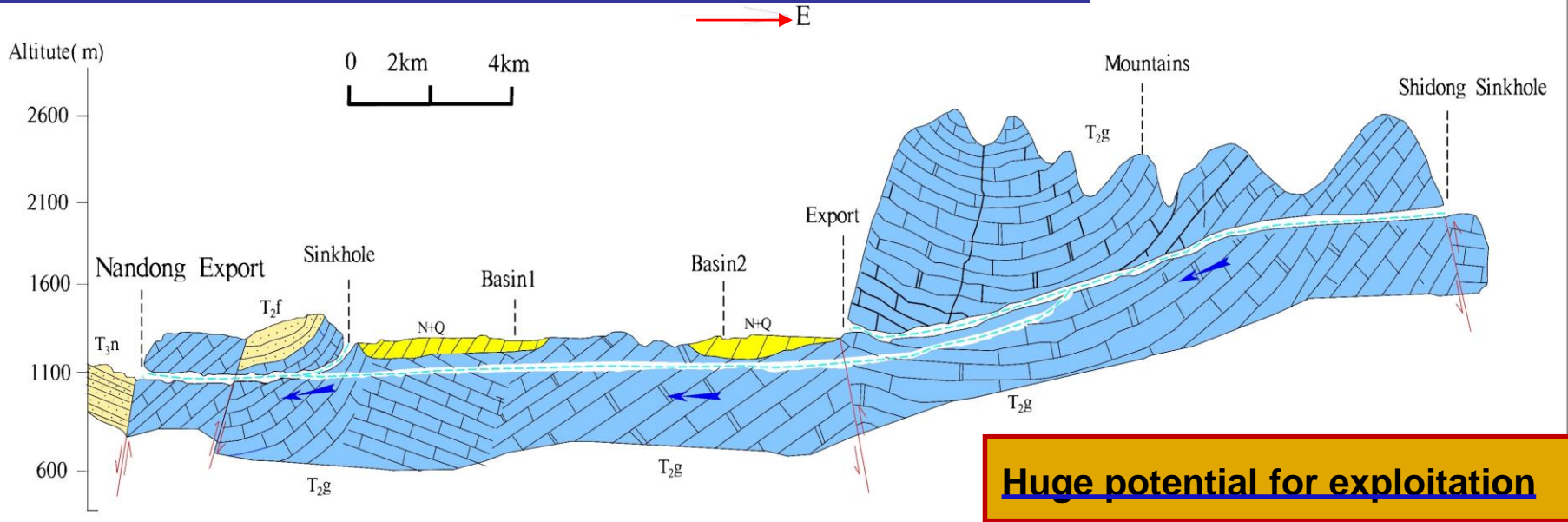
Altitude:

Basins 1200m-1300m

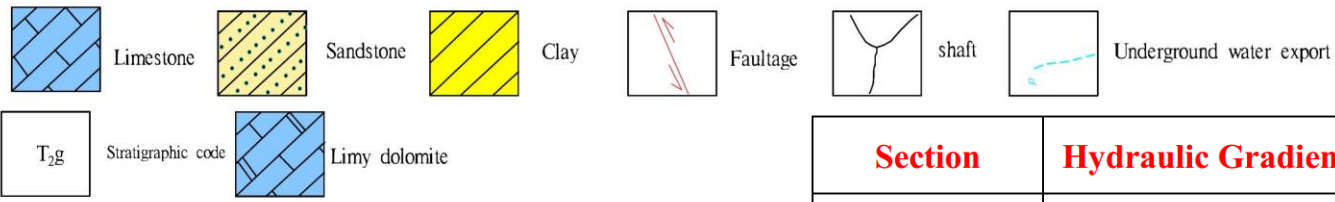
Mountains 1200m-1300m

the export was only and concentrated

1. Introduction



Huge potential for exploitation



Type	Groundwater Resource
Allowable withdrawal	$284.2 \times 10^3 \text{ m}^3/\text{d}$
Has been exploited	$25.5 \times 10^3 \text{ m}^3/\text{d}$
Remaining amount	$258.6 \times 10^3 \text{ m}^3/\text{d}$

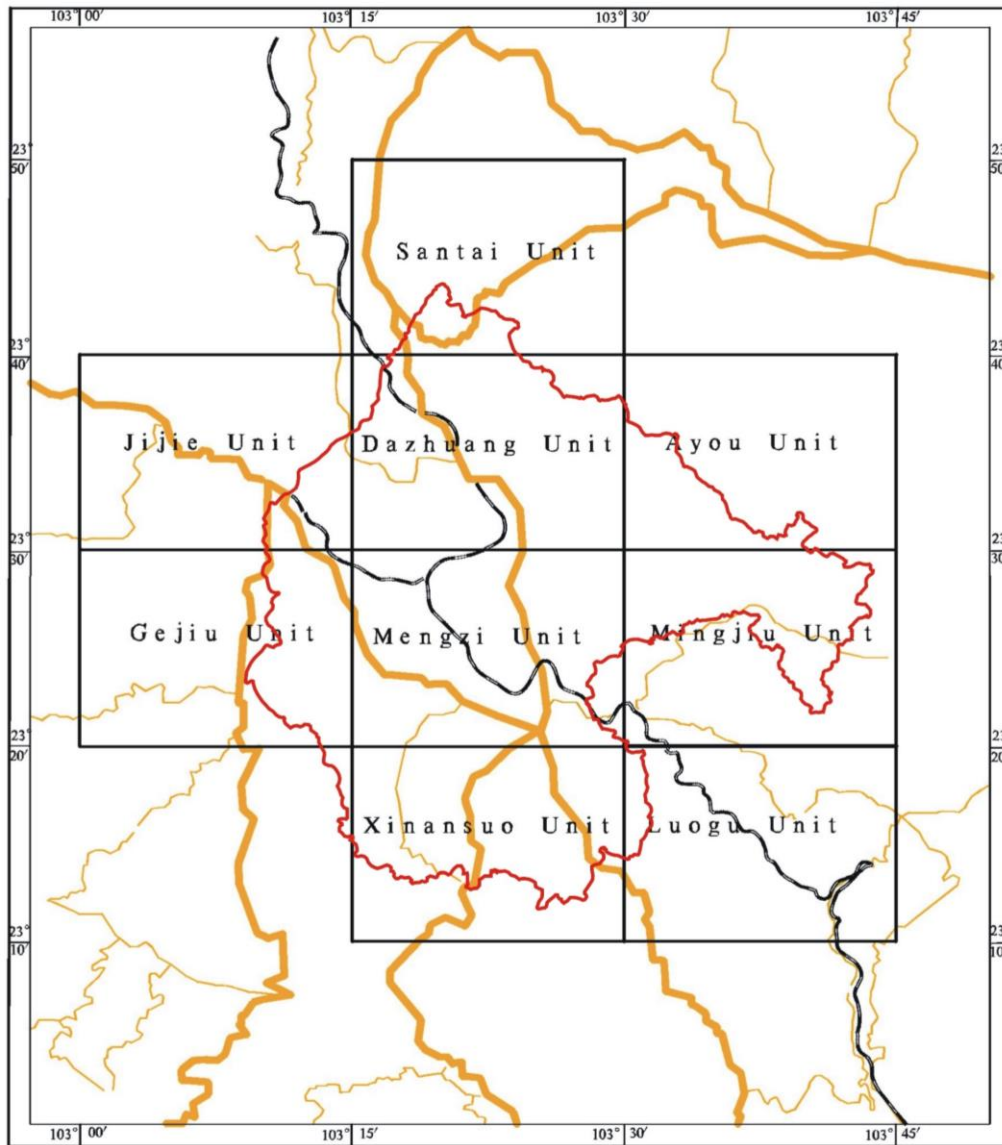
Section	Hydraulic Gradient(%)	Average(%)
Upstream	21.9~25.4	10.8~14.5
Midstream	4.8~7.5	
Downstream	2.2~7.2	

Karst funnel, sinkhole, depression, shaft and so on are about 4 thousands in mountain area

2. Work and Research





**Nine of 1:50000 Mappable
Units Hydrogeology Survey**

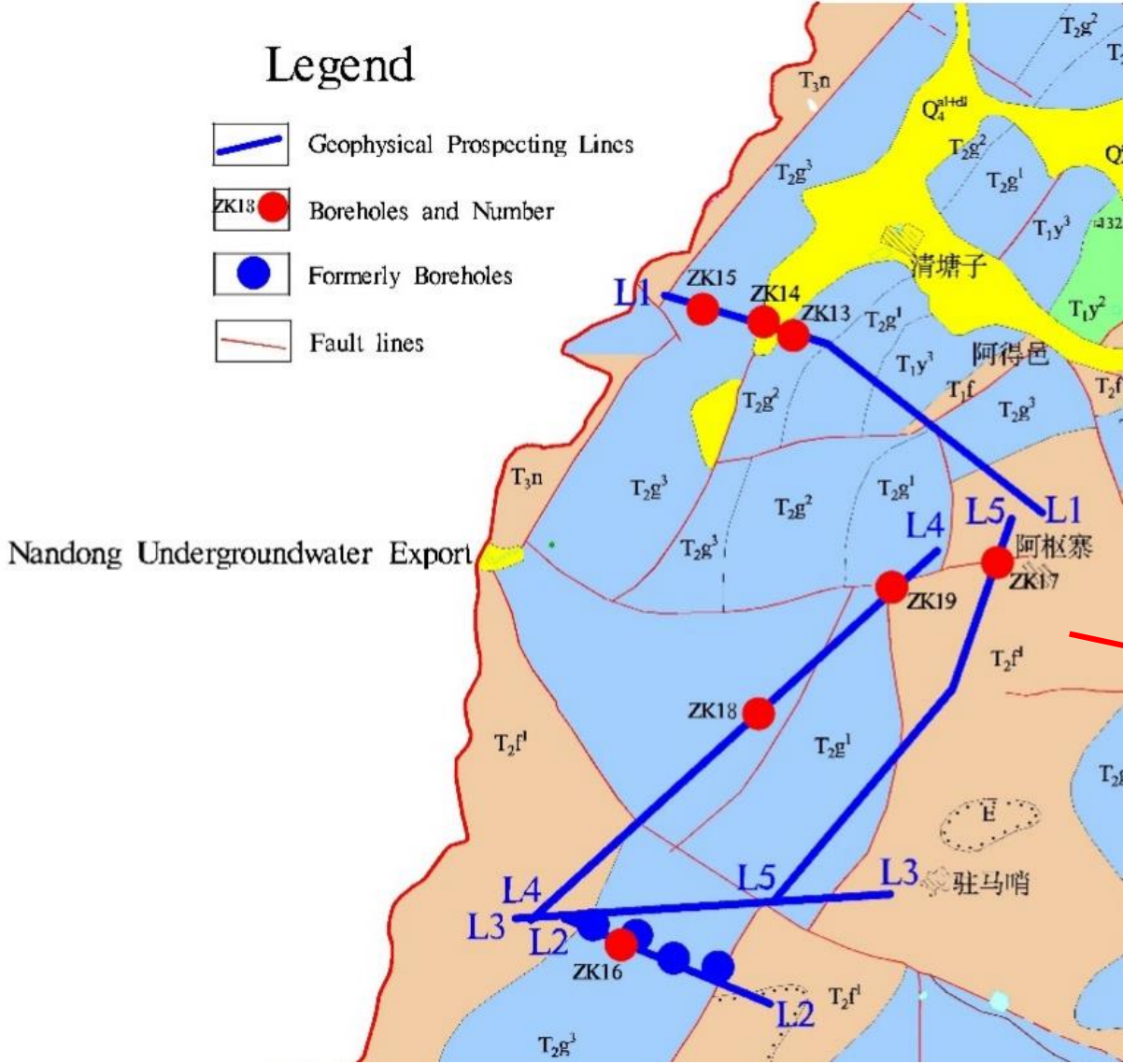
In order to rational exploit the groundwater resource and treat the environment problems in Nandong underground water system, Chinese Government has devoted huge manpower and material resources. A geological survey and research project was started up by China Geological Survey to find hydrogeological characteristics and comprehensive exploitation strategy for Nandong underground river system from 2014 to 2015.



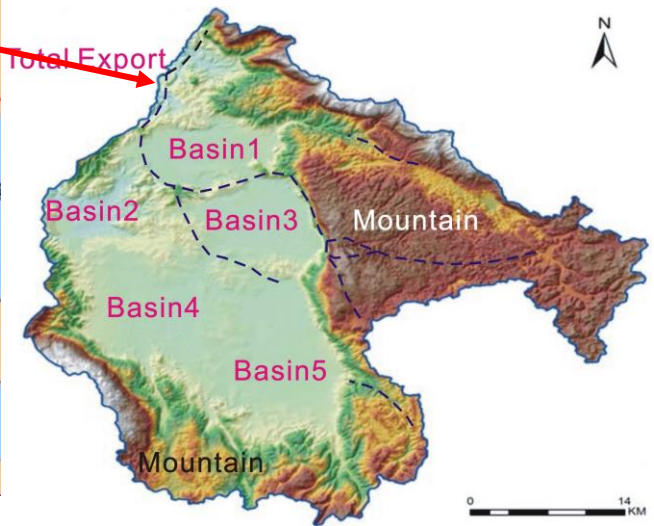
2. Work and Research

Legend

-  Geophysical Prospecting Lines
-  Boreholes and Number
-  Formerly Boreholes
-  Fault lines



Geophysical Prospecting and Drilling

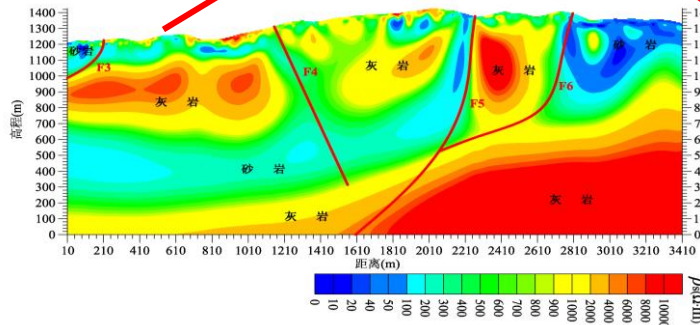
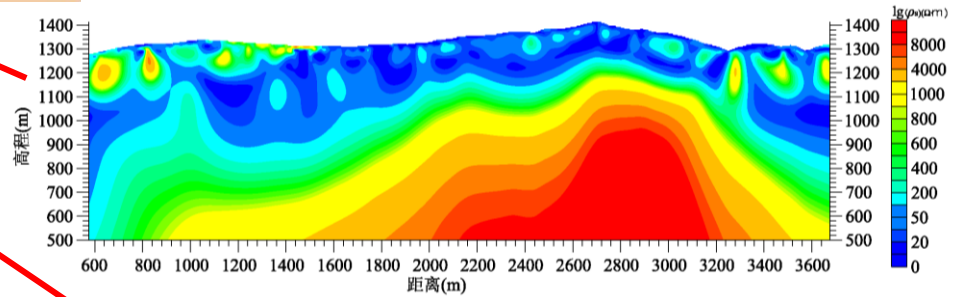
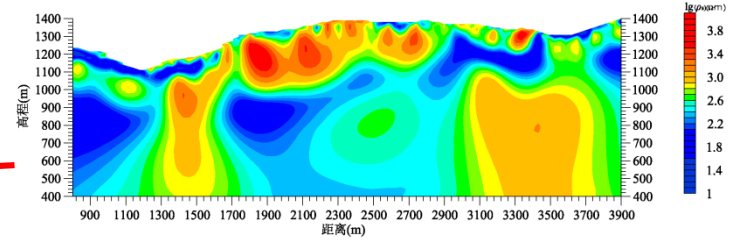
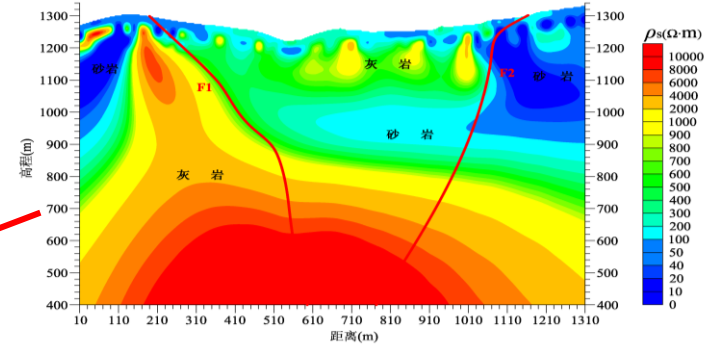
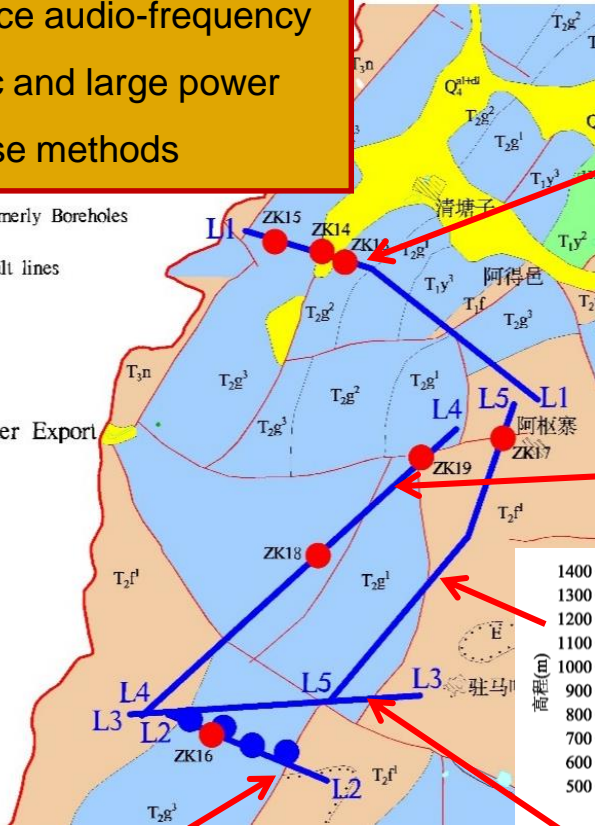


2. Work and Research

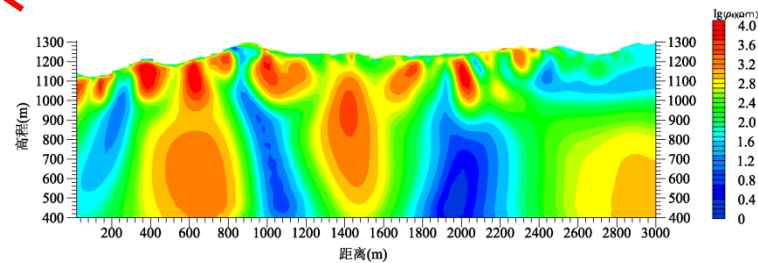
controlled source audio-frequency magnetotelluric and large power mise-à-la-masse methods

- Formerly Boreholes
- Fault lines

Nandong Undergroundwater Export







云南南洞地下河L3线可控源音频大地电磁法(CSAMT)二维反演结果断面图

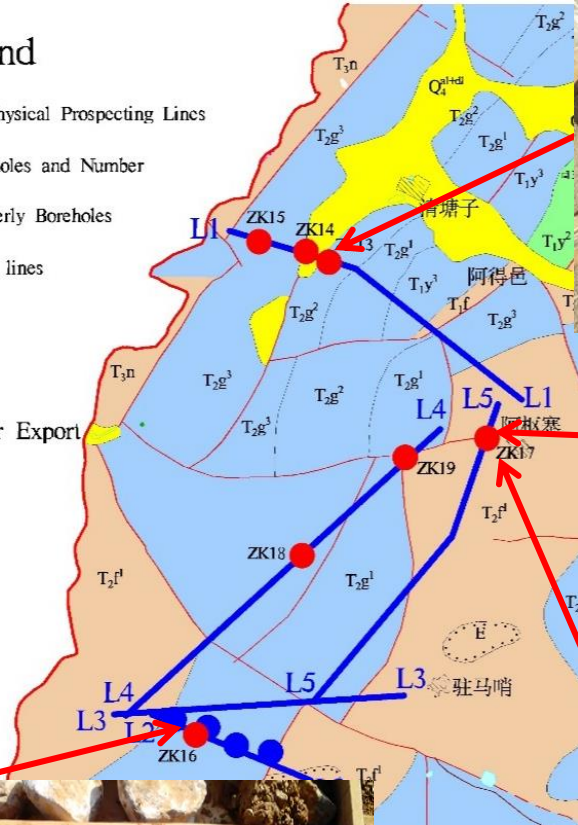


Pebbles and sand, Cores from 165m-175m underground

Legend

-  Geophysical Prospecting Lines
-  Boreholes and Number
-  Formerly Boreholes
-  Fault lines

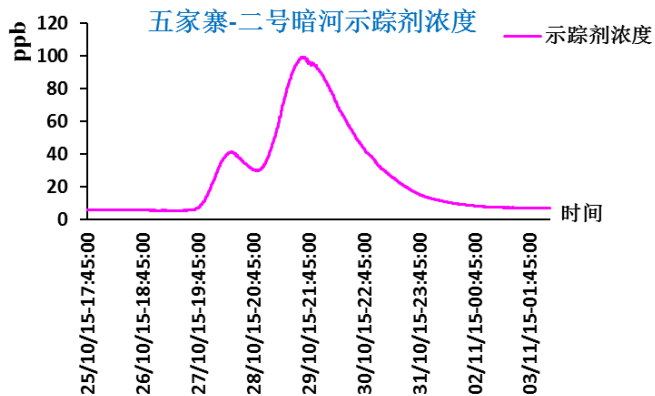
Nandong Undergroundwater Export



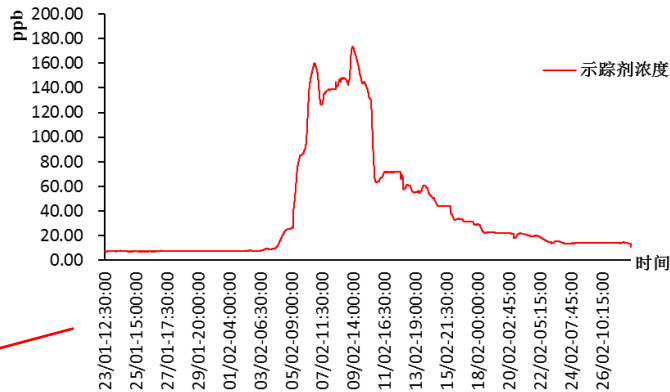
Find a cave, 4.6m high
340m underground



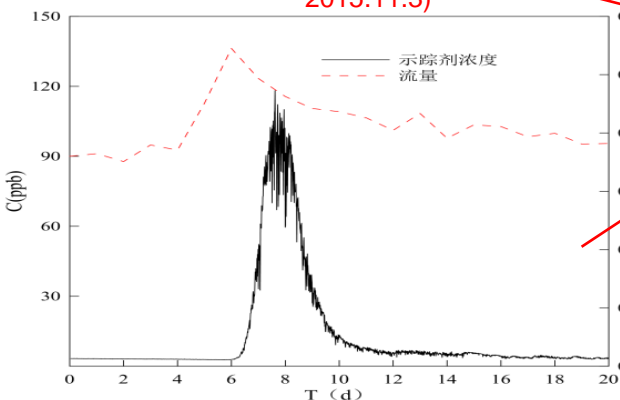
Tracer Test



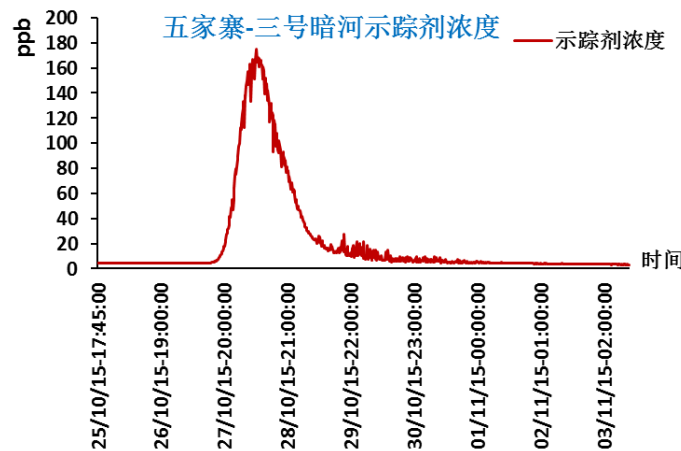
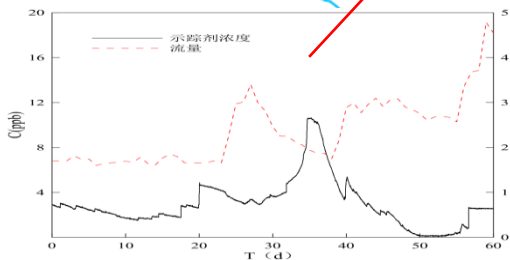
Duration curve of the tracer concentration and flow at the exit of No.2 underground river (2015.10.24-2015.11.3)



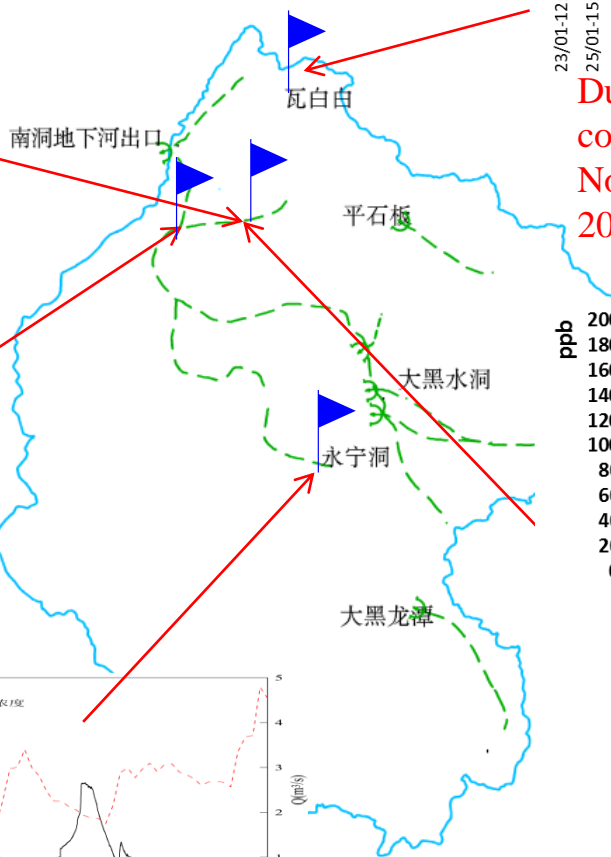
Duration curve of the tracer concentration and flow at the exit of No.1 underground river (2015.1.23-2015.2.28)



Duration curve of the tracer concentration and flow at the exit of No.3 underground river (2015.12.24-2016.1.13)



Duration curve of the tracer concentration and flow at the exit of No.3 underground river (2015.10.24-2015.11.3)



Tracer Test

Receiving Point1



Tropping Point1



Tropping Point2

南洞地下河出口



Tropping Point5



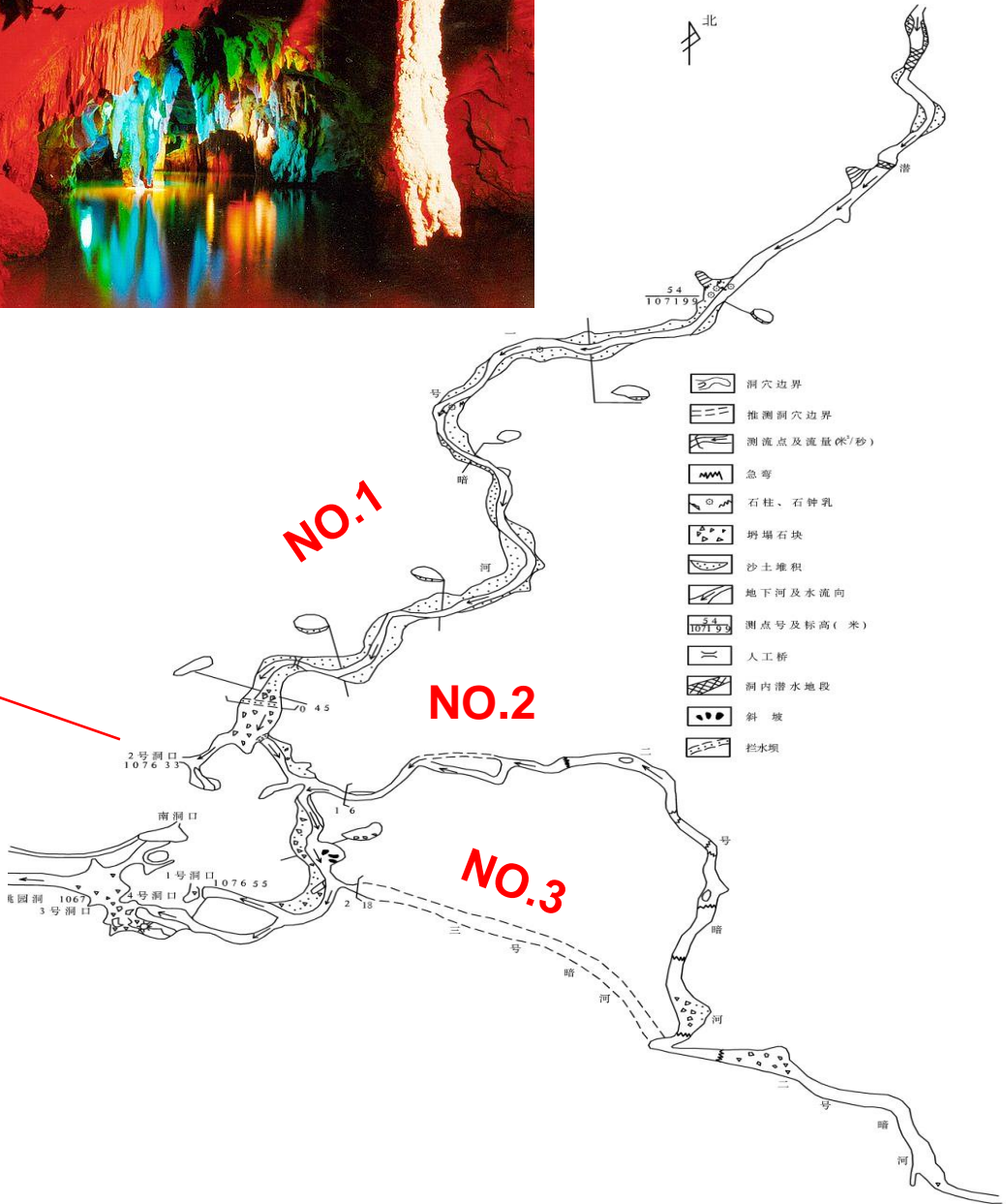
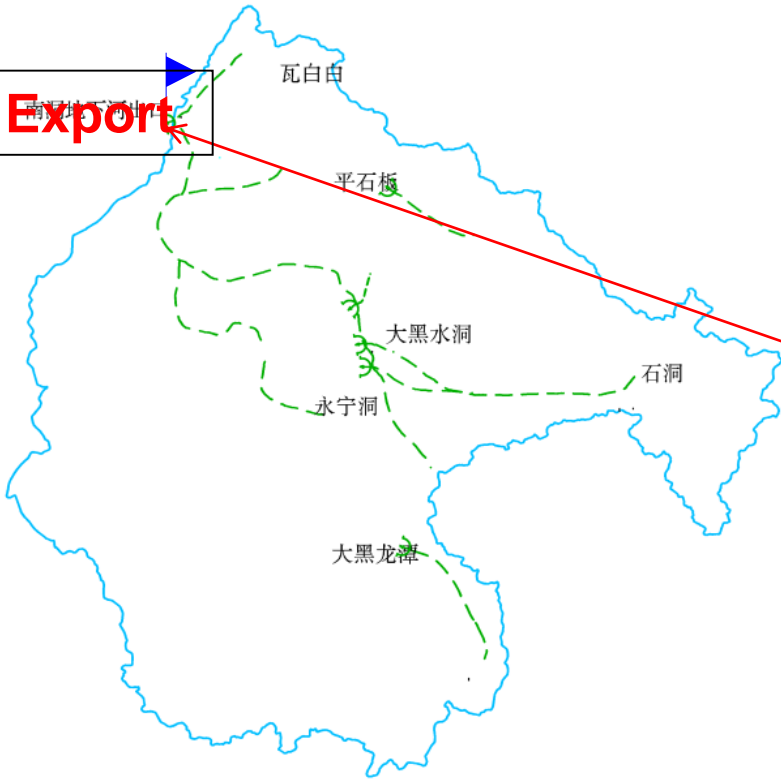
Tropping Point3



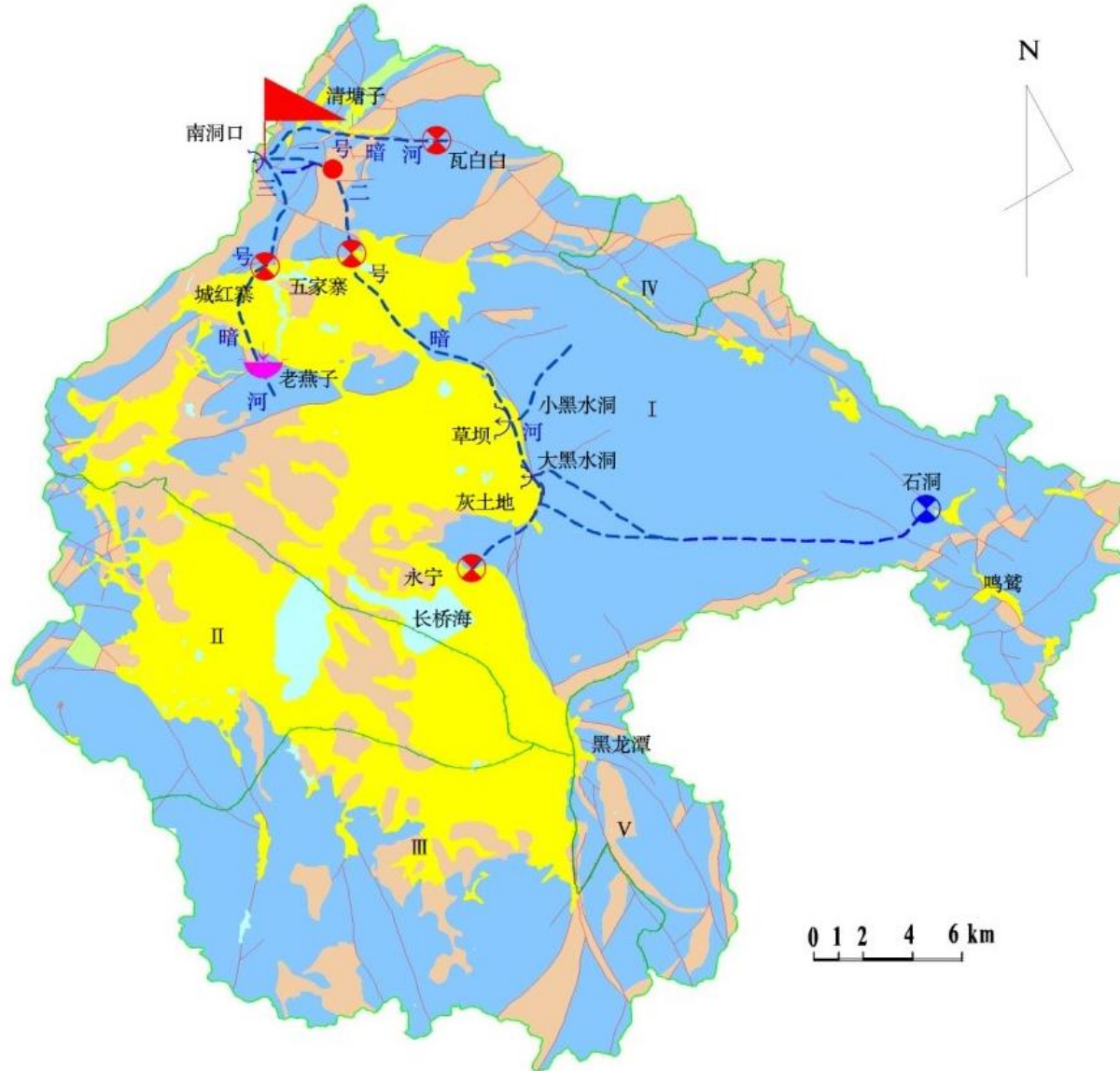
CAVE DETECTION



Export

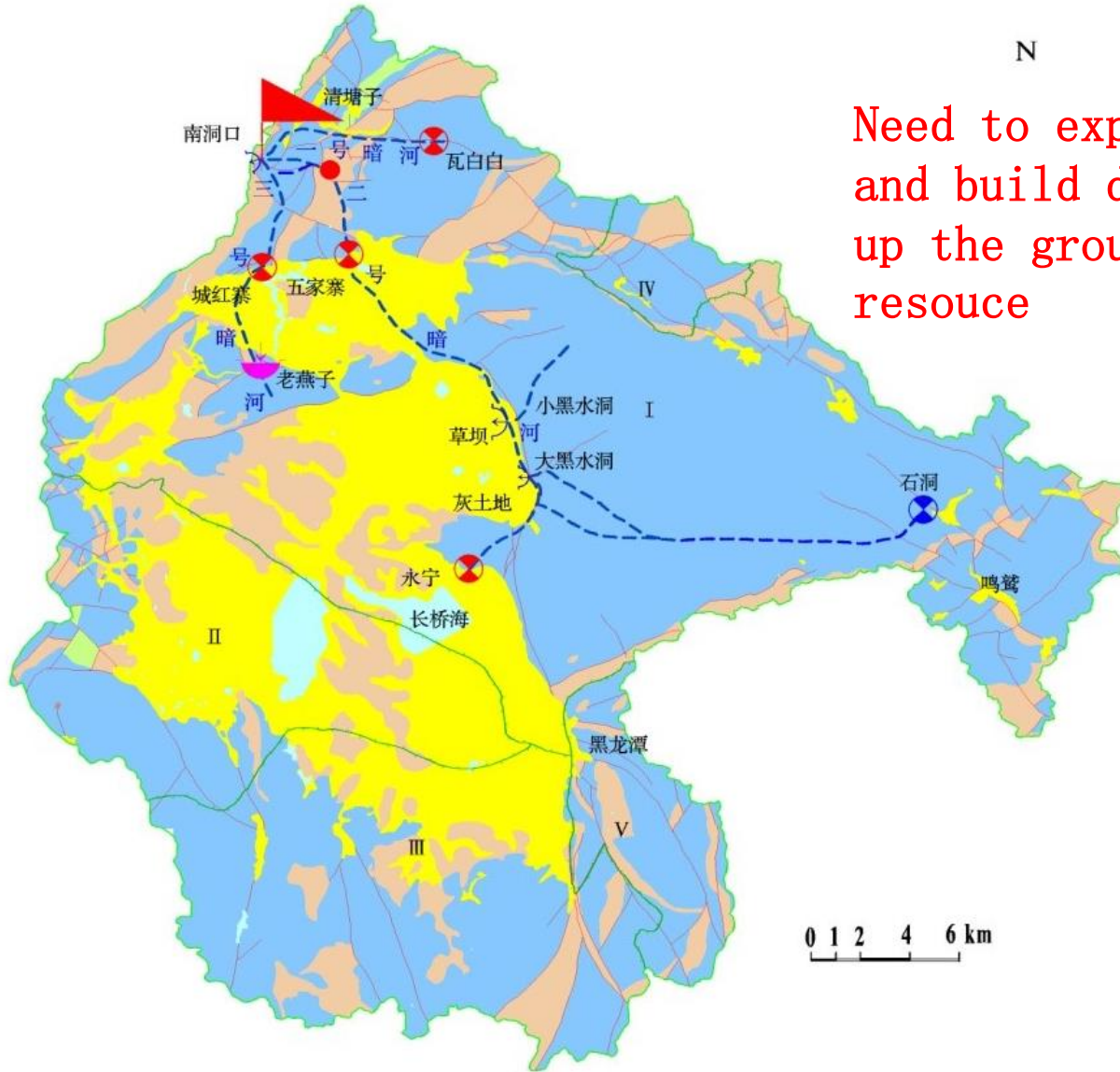


3. Results



Distribution of the main underground channels and runoff belts

4. Strategy



Need to exploration target further and build dam underground to hold up the groundwater and exploit the resource

Thank you for your attention

