FLOW AND HYDROGEOCHEMICAL MODEL OF THE YUCATÁN GROUNDWATER FLOW SYSTEM.

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INTRODUCTION

- REGIONAL GROUNDWATER FLOW SYSTEM (SIRAS): YUCATÁN (ESCOLERO-FUENTES, 2018)
- KARSTIC SYSTEM WITH A VERY HIGH PERMEABILITY.
- FRESWATER CONSISTS OF LENS THAT FLOATS ABOVE A DENSER SALINE WATER.

OBJECTIVE: UNDERSTAND THE DYNAMICS OF THE GROUNDWATER FLOW SYSTEM IN YUCATAN BY COUPLING FLOW AND TRANSPORT PROCESSES WITH HYDROGEOCHEMICAL EVOLUTION.

METHODOLOGY

GROUNDWATER SAMPLING

MAY TO JUNE 2023 IN THE STATE OF YUCATÁN.

- 83 GROUNDWATER SAMPLES WERE OBTAINED FOR MAJOR ION ANALYSIS.
- FIELD MEASUREMENT OF PHYSICOCHEMICAL PARAMETERS.

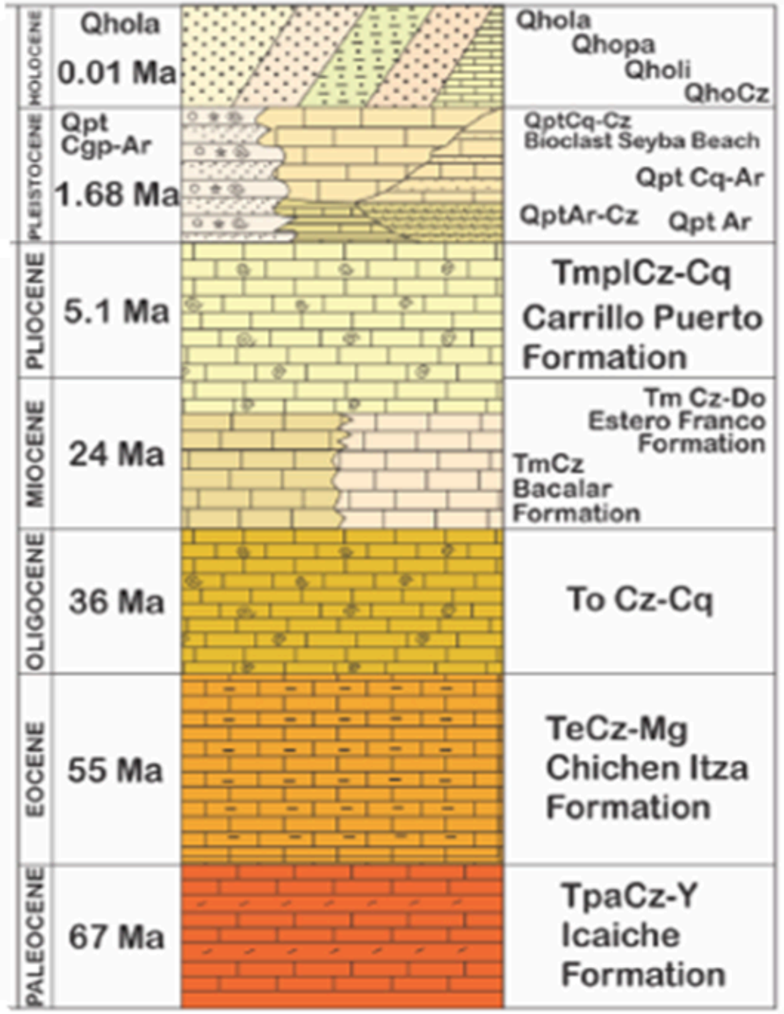
CONCEPTUAL MODEL

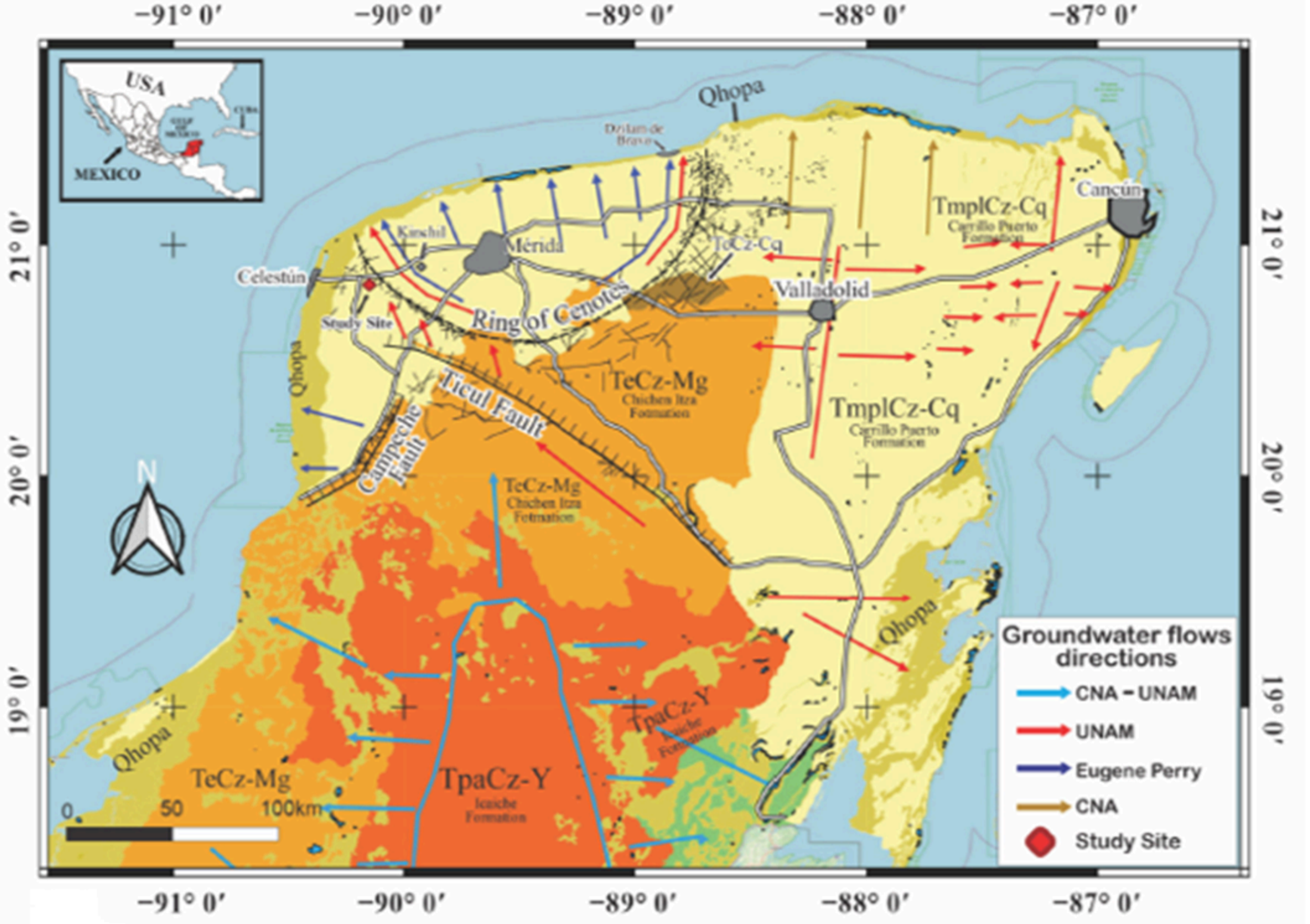
- GEOLOGY
- TOPOGRAPHY
- HIDROGEOCHEMICAL ANALISIS
- FLOW NETWORK

FLOW AND HIDROGEOCHEMISTRY MODEL 1D

- LOCATION AND GEOMETRY OF THE MODEL.
- HYDROGEOCHEMICAL PROCESSES THAT CONTROL GROUNDWATER CHEMISTRY.
- HYDRAULIC PARAMETERS

CONCEPTUAL MODEL





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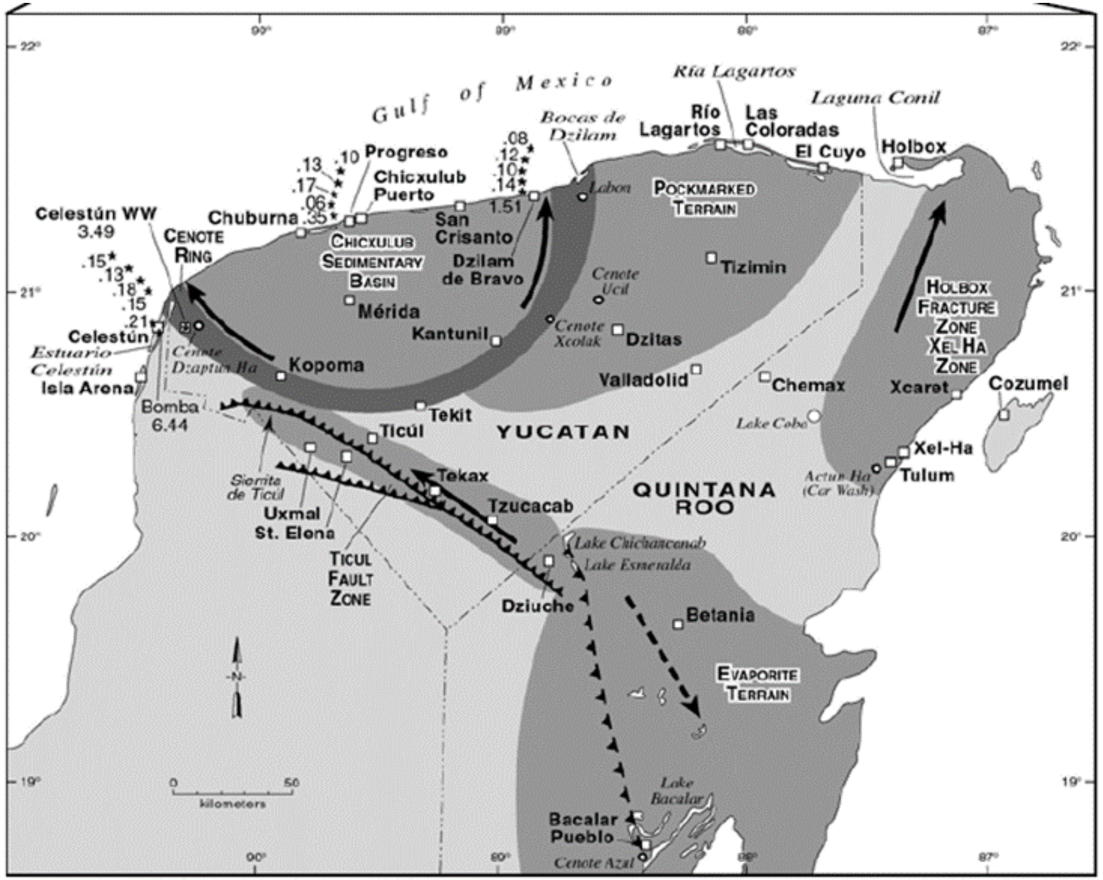
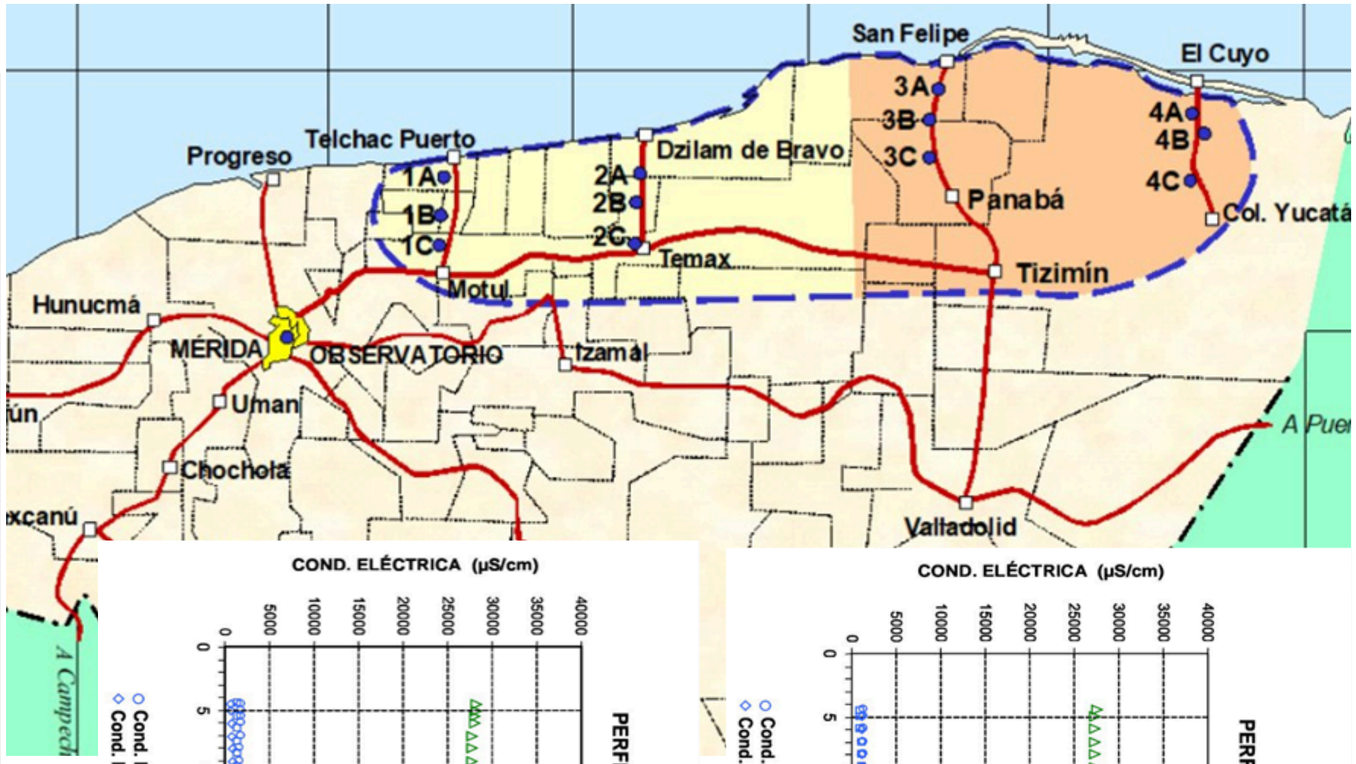
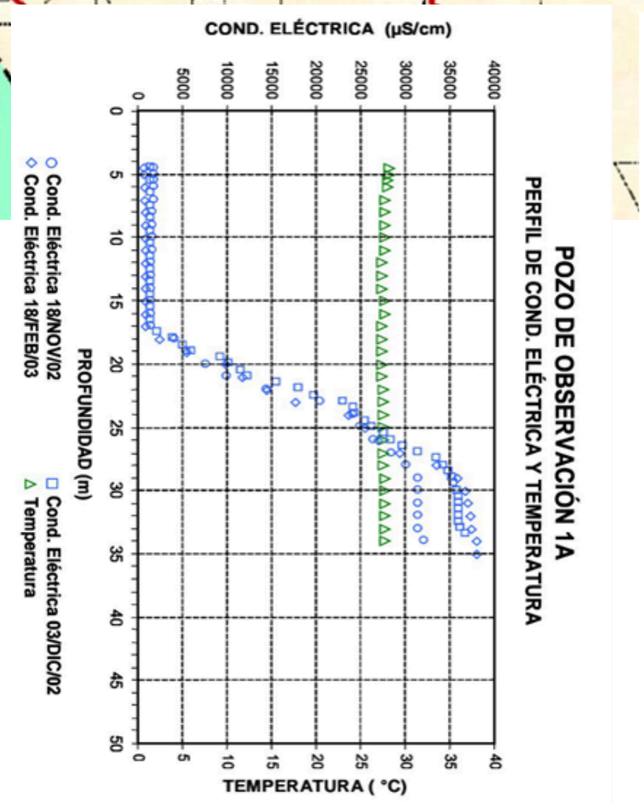
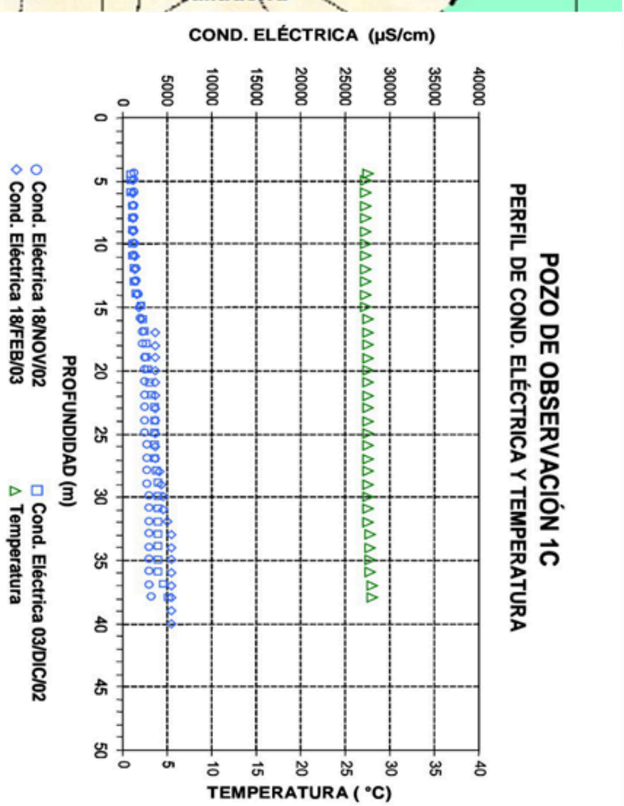






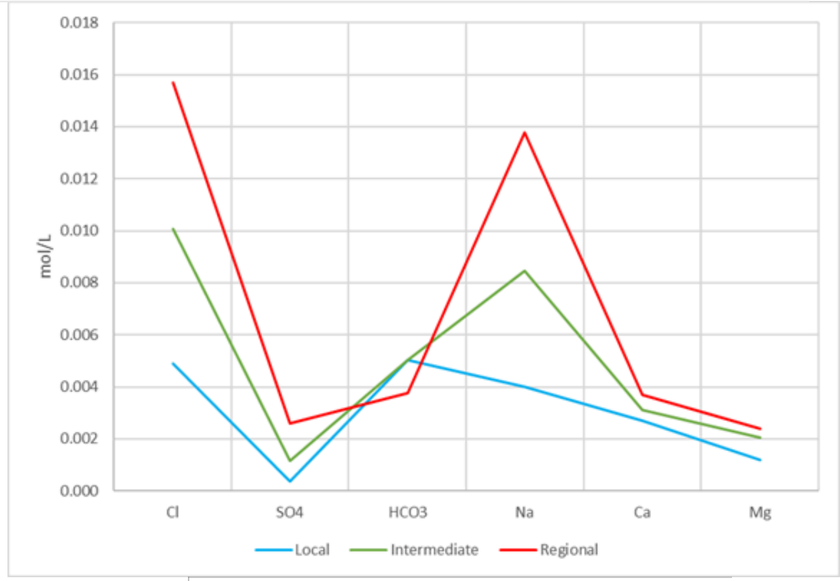


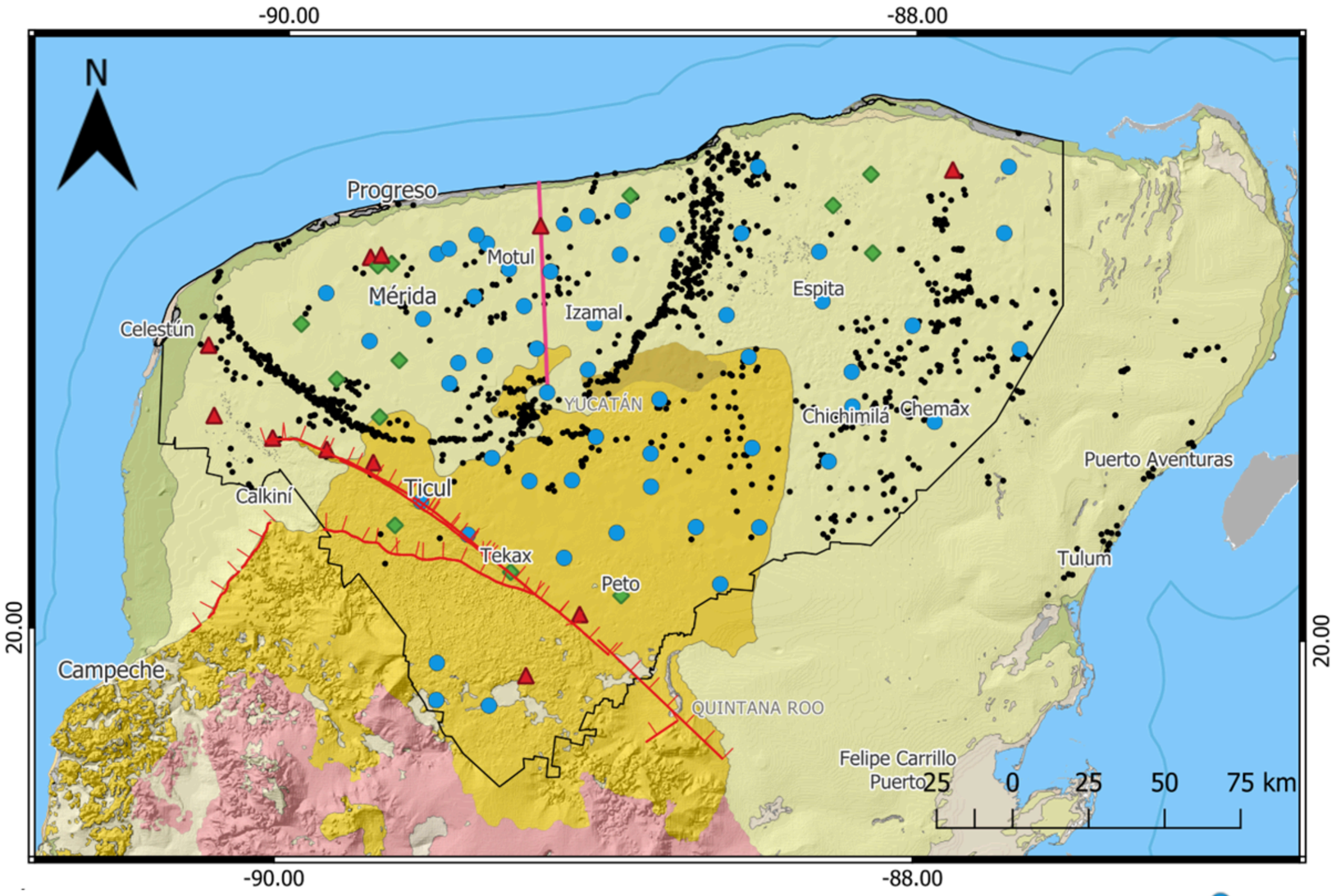
THE DYNAMICS OF GROUNDWATER FLOW IS CONTROLLED BY THE FOLLOWING FACTORS

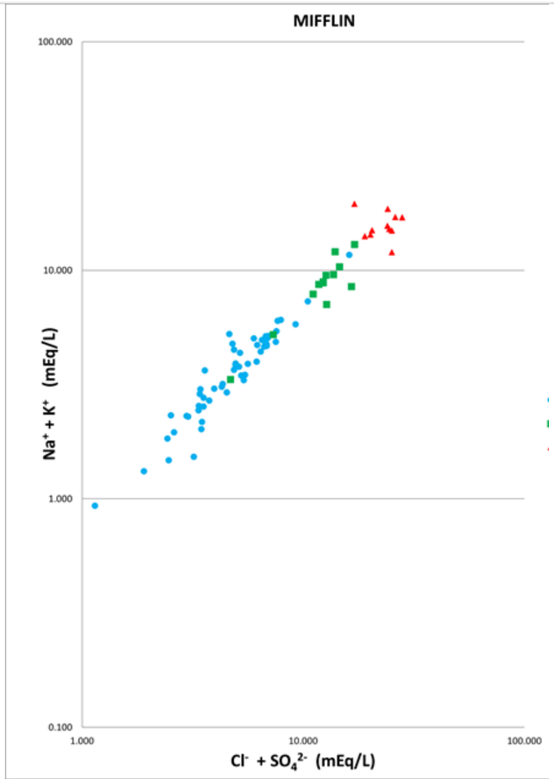
- TICUL FAULT
- RING OF CENOTES
- COASTLINE, REGIONAL DISCHARGE

FLOW SYSTEM COMPONENTS

HCO_3^- → HCO_3^- y $SO_4^=$ → $SO_4^=$ → $SO_4^=$-- y Cl^- → Cl^-

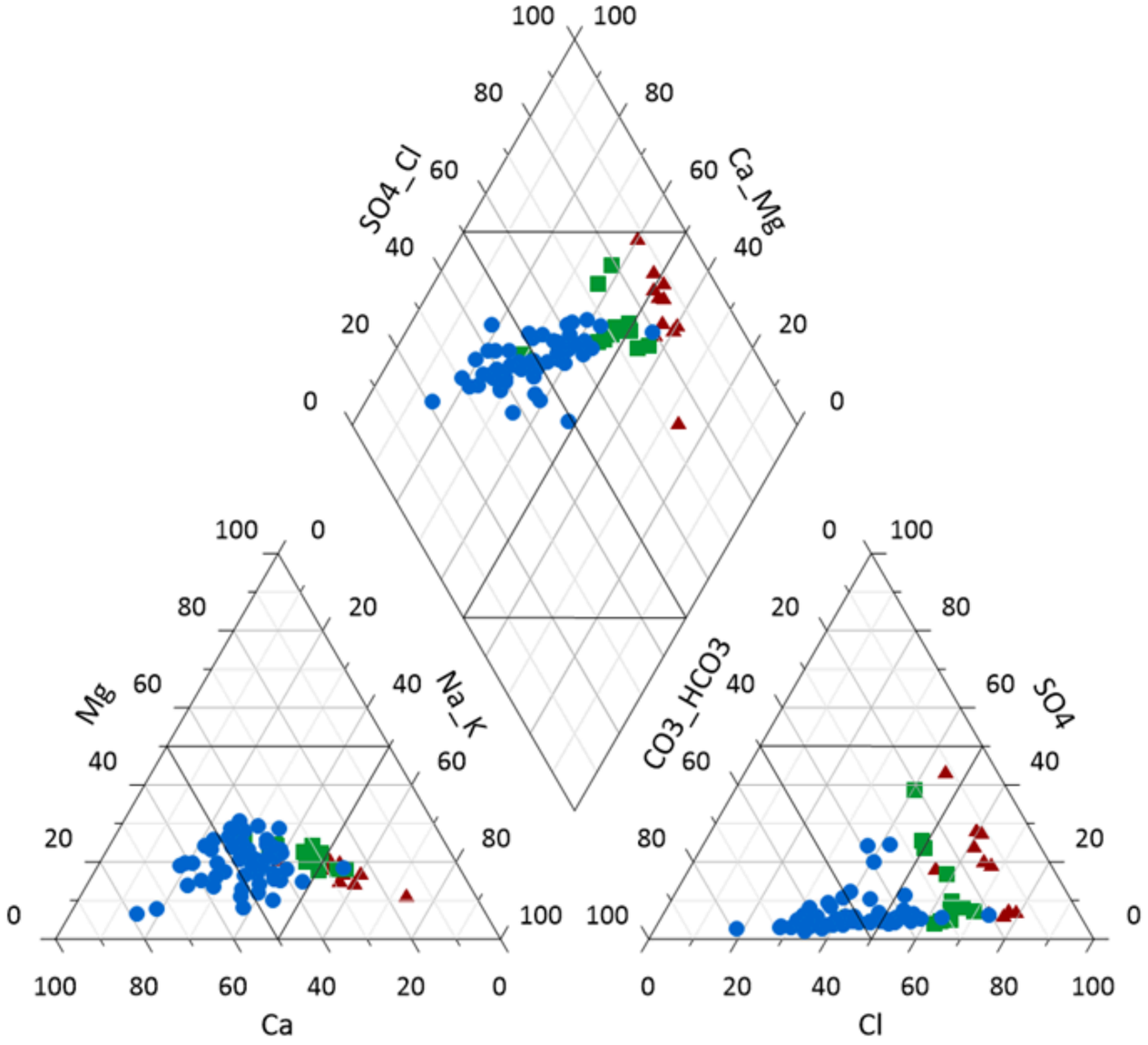






- Local
- Intermediate
- Regional

HIDROGEOCHICAL PROCESS



CATION EXCHANGE AT THE SALT/FRESH WATER INTERFACE

2NA+ + CA-X2 -> NA-2X + CA2+

DISSOLUTION FO CARBONATE ROCKS

CALCITE

CACO3 + H2O + CO2 <-> CA2++2HCO3-

DOLOMITE

CAMG(CO3)2 + 2H2O + 2CO2 <->
CA2++MG2++4HCO3-

GYPSUM

CASO4 . H2O -> CA2++SO42-+2H2O

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CONCLUSIONS

3 COMPONENTS OF THE REGIONAL GROUNDWATER FLOW SYSTEM WERE DEFINED.

LOCAL COMPONENT: TYPE HCO3-CA-MG, IS FOUND COVERING THE STATE OF YUCATÁN AND IS INFLUENCED BY THE CURRENT CLIMATE.

INTERMEDIATE COMPONENT: COMPONENT WITH INTERMEDIATE COMPOSITION SO4-CL, AS IT IS DEEPER THAN THE LOCAL ONE.

REGIONAL COMPONENT: THE MOST EVOLVING CL-NA TYPE COMPONENT, WITH THE LONGEST AND DEEPEST TRAJECTORY, DISCHARGES ON THE TICUL FAULT AND THE COASTLINE.

THE HYDROGEOCHEMICAL EVOLUTION OF THE COMPONENTS IS DOMINATED BY CARBONATE DISSOLUTION PROCESS AND MIXING WATER. THESE REACTIONS ARE THE ONES THAT WILL BE COUPLED TO THE 1D TRANSPORT MODEL.

REFERENCIAS

•ESCOLERO-FUENTES., O. A. (2018). SISTEMAS REGIONALES DE AGUA SUBTERRÁNEA EN MÉXICO. INSTITUTO MEXICANO DE TECNOLOGÍA DEL AGUA.

•FREEZE, R. A., & CHERRY, J. A. (1979). GROUNDWATER. PRENTICE-HALL, INC.

•GONZALEZ-HERRERA, R. A. (1984). CORRELACIÓN DE MUESTRAS DE ROCA EN POZOS DE LA CIUDAD DE MÉRIDA [B.S. TESIS]. UNIVERSIDAD AUTÓNOMA DE YUCATÁN

•MARIN, L. E., PERRY E.C., ESSAID, H. I., & STEINICH, B. (2004). HYDROGEOLOGICAL INVESTIGATIONS AND NUMERICAL SIMULATION OF GROUNDWATER FLOW IN THE KARSTIC AQUIFER OF NORTHWESTERN YUCATAN, MEXICO. IN A. CHENG & D. OUAZAR (EDS.), COASTAL AQUIFER MANAGAMENT: MONITORING, MODELING, AND CASE STUDIES (PP. 197–212).

•MARTÍNEZ, C., MORENO, M., & LIEDL, R. (2019). ESTIMATING POLLUTANT RESIDENCE TIME AND NO3 CONCENTRATIONS IN THE YUCATAN KARST AQUIFER; CONSIDERATIONS FOR AN INTEGRATED KARST AQUIFER VULNERABILITY METHODOLOGY: WATER, 11 (7), 1431.

•PERERA-BURGOS, J. A., ALVARADO-IZARRARAS, L. G., MIXTECO-SÁNCHEZ, J. C., CANUL-MACARIO, C., ACOSTA-GONZÁLEZ, G., GONZÁLEZ-CALDERÓN, A., ... & LI, Y. (2024). HYDROGEOPHYSICAL EVALUATION OF THE KARST AQUIFER NEAR THE WESTERN EDGE OF THE RING OF CENOTES, YUCATÁN PENINSULA. WATER, 16(14), 2021.

•PERRY, J. S., GAMBOA, J., REEVE, A., SANBORN, R., MARIN, L., & VILLASUSO, M. (1989). GEOLOGIC AND ENVIRONMENTAS ASPECTS OF SURFACE CEMENTATION NORTH COAST, YUCATÁN, MEXICO. GEOLOGY, 17(V), 818–821.

•REZAEI, M., SANZ, E., RAEISI, E., AYORA, C., VÁZQUEZ-SUÑÉ, E., & CARRERA, J. (2005). REACTIVE TRANSPORT MODELING OF CALCITE DISSOLUTION IN THE FRESH-SALT WATER MIXING ZONE. JOURNAL OF HIDROGLOGY, 31(1), 282–298.

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