

Federica Lanza

# Plio-Quaternary kinematics and geometry of the Calama-Olacapato-El Toro fault zone across the Puna Plateau, Argentina

*A brief overview of my MS Thesis project and INVOGE experience*



**UMB**

Supervisor: Prof. A. Tibaldi

Assistant supervisor: Prof. C. Corazzato

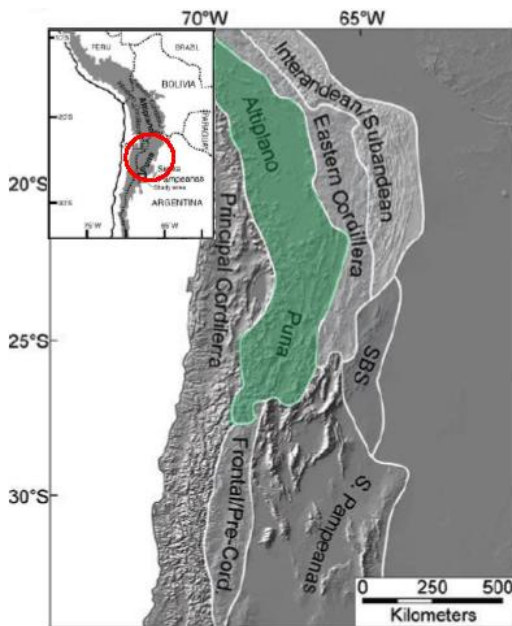
**MTU**

Supervisor: Prof. G. P. Waite

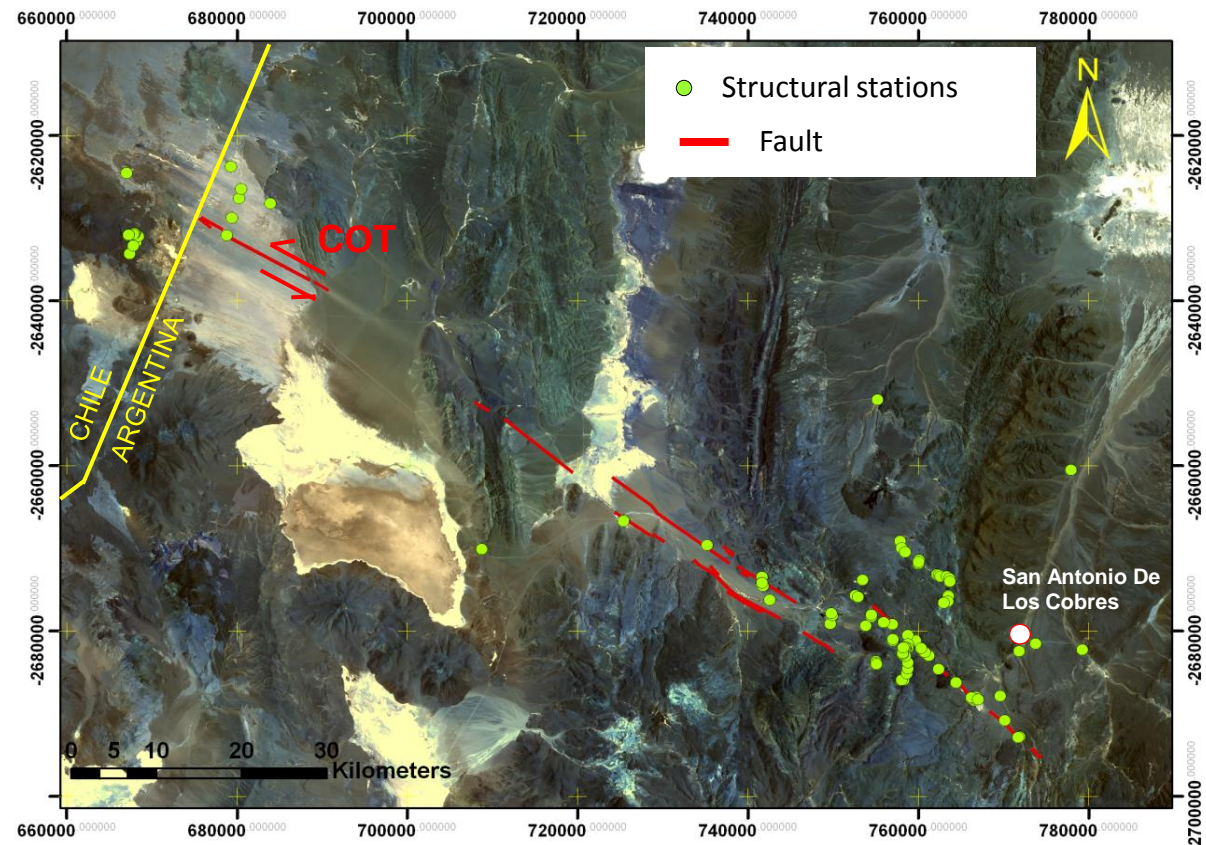
# PURPOSE OF THE WORK

## Introduction

Geological and structural field data were collected along The Calama-Olacapato-El Toro (COT) fault zone, where it crosses the Puna Plateau (Argentina).



After Jordan et al. (1983)



## Principal Aims

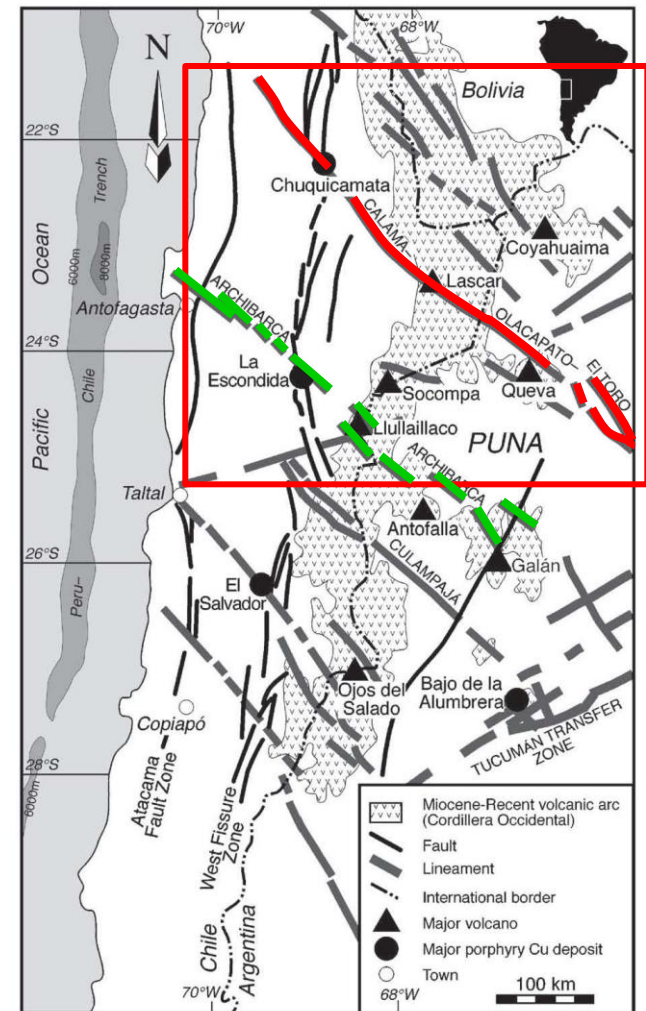
- To reconstruct the fault kinematics and the fault geometries through the individuation of striated fault planes and the offset of surface deposits and landforms.
- To perform a **stress analysis** through time by
  - (I) reconstructing the paleostress tensor using stress-inversion methods
  - (II) determining stress orientations via study and new calculations of focal mechanisms
- To connect faults with recent seismic events and provide information about the seismic risk of the region

## GEOLOGICAL AND STRUCTURAL SETTING

### *The Calama – Olacapato – El Toro Fault Zone (COT)*

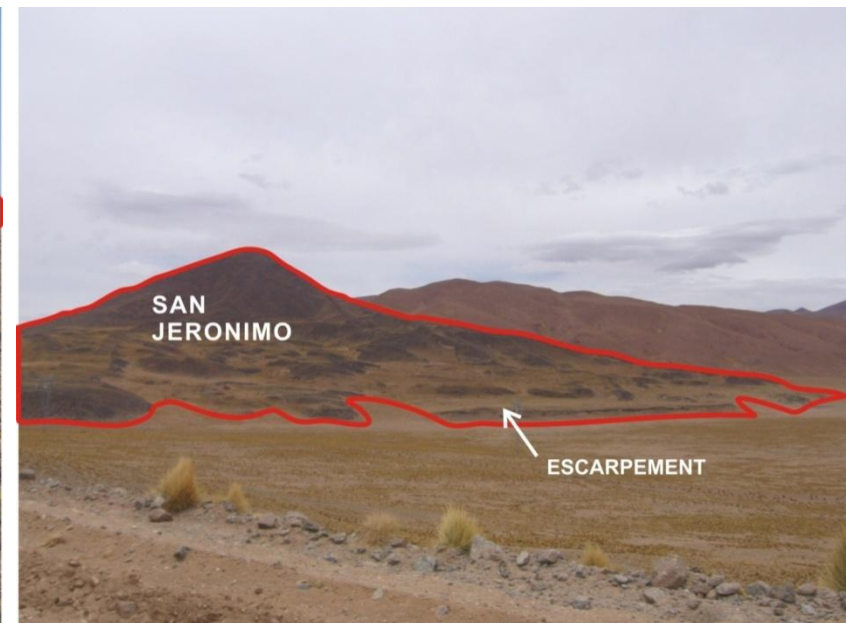
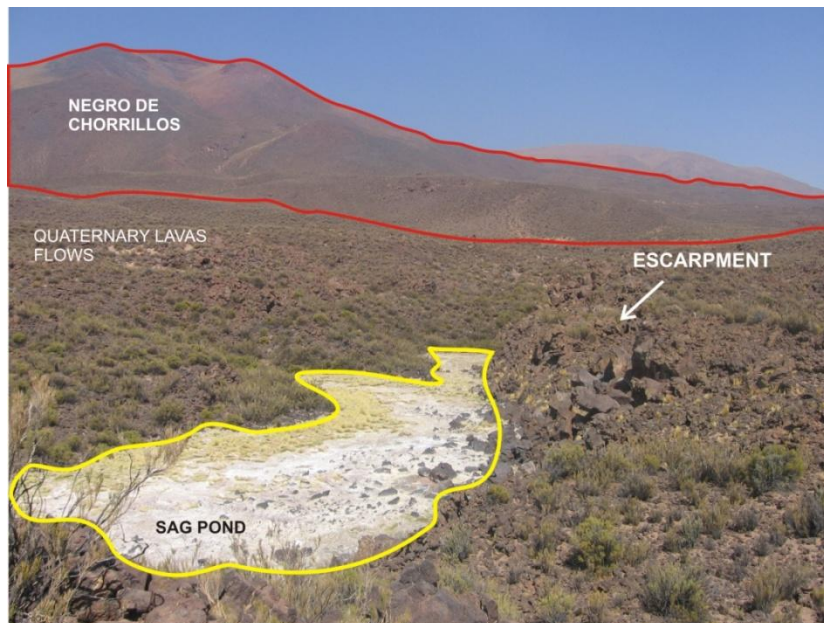
- Transversally crosses the Andean chain and the Puna Plateau at about 24° S.
- NW-SE trending left-lateral trascurrent fault system
- Can be considered the surface expression of ancient deep crustal trans-lithospheric structures, which have been periodically reactivated
- Along with the **Archibarca Transverse Zone**, the **COT** is considered a bounding structure of regional importance

*From Chernicoff et al. (2002)*



## The Calama – Olacapato – El Toro Fault Zone (COT)

- Creates favourable tectonic conditions for the locus of mineralizations.
- Young volcanic activity (from Miocene to recent times) developed along this fault zone forming an important NW-SE trending volcanic belt constituted by several stratovolcanoes , monogenetic cones and calderas. E.g: Tuzile, San Jeronimo, Negro De Chorrillos



## WHAT I HAVE DONE

### *Field activities*

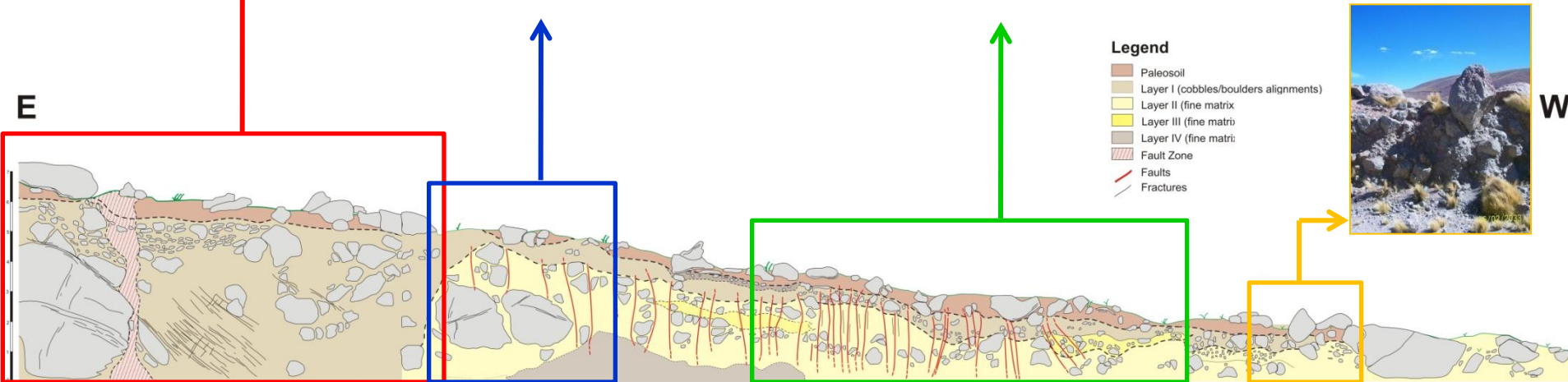
- Interpretation of satellite images
- Field surveys:
  - Faults measurements (dip direction, dip angle, pitch and kinematic indicators)
  - Geomorphological observations
  - Calculation of river offsets and associated slip rates
  - Logs of paleosismological sections



## Example of paleoseismological section



- Fault gauge, pebble and boulder alignments
- High density of fractures and secondary faults
- Faulting occurred during multiple events with surface ruptures



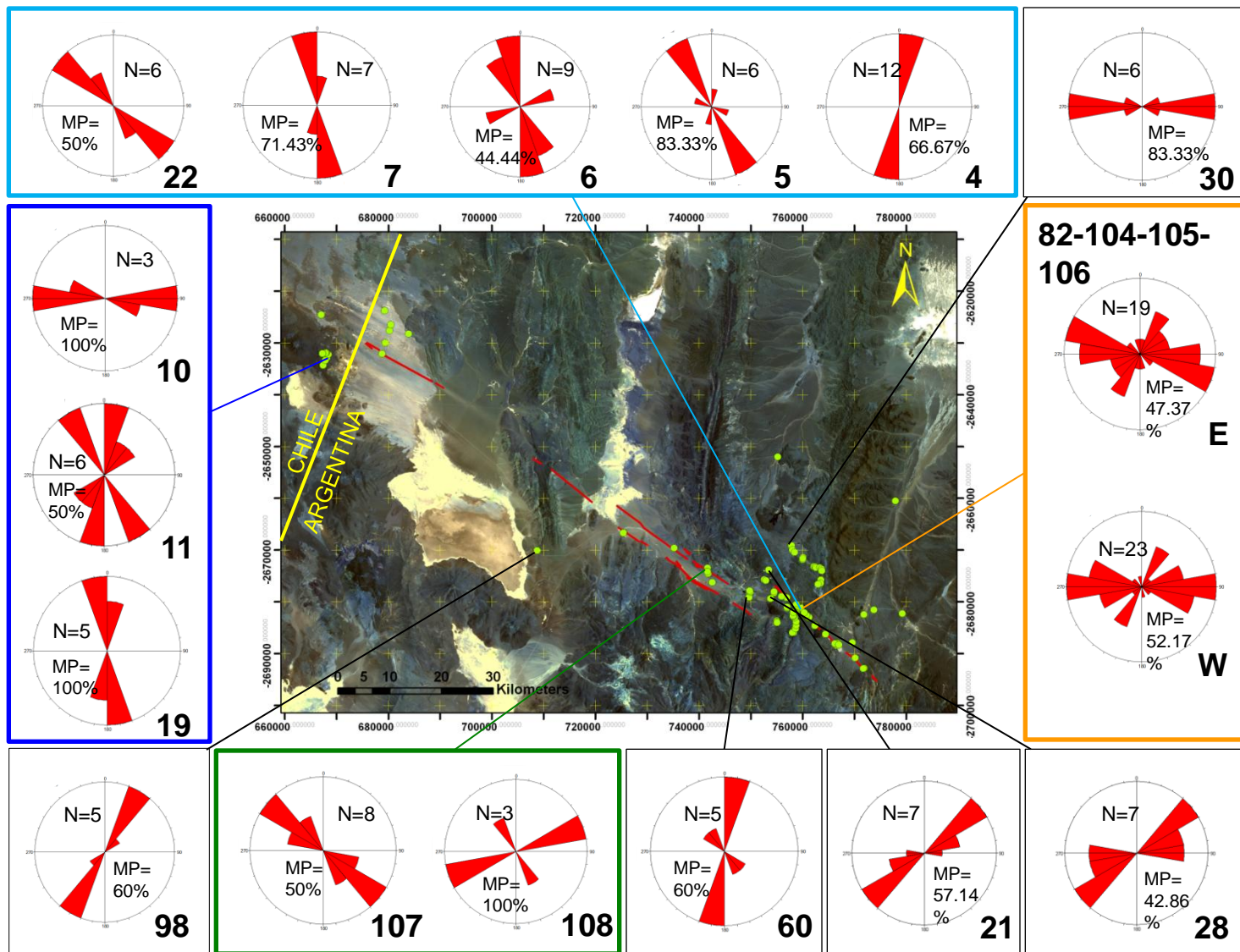
## *First Assumptions from structural data, and measurements collected in the field*

- Faults offset Pliocene or Pleistocene volcanic deposits suggesting a Plio-Quaternary activity of the Puna Plateau segment of the COT fault zone.
- The surface trace is rectilinear suggesting a vertical dip at least in the uppermost crust.
- Considering the kinematics, a vertical component is usually present in the form of relative uplift of the northeastern tectonic block.
- In the Chilean region, field evidence of Plio-Quaternary motions disappears and so the COT lineament should be older there.
- **Open fissures** are only partially filled and are not located along or close to slopes. They might be interpreted as evidence of prehistoric/historic surface faulting.

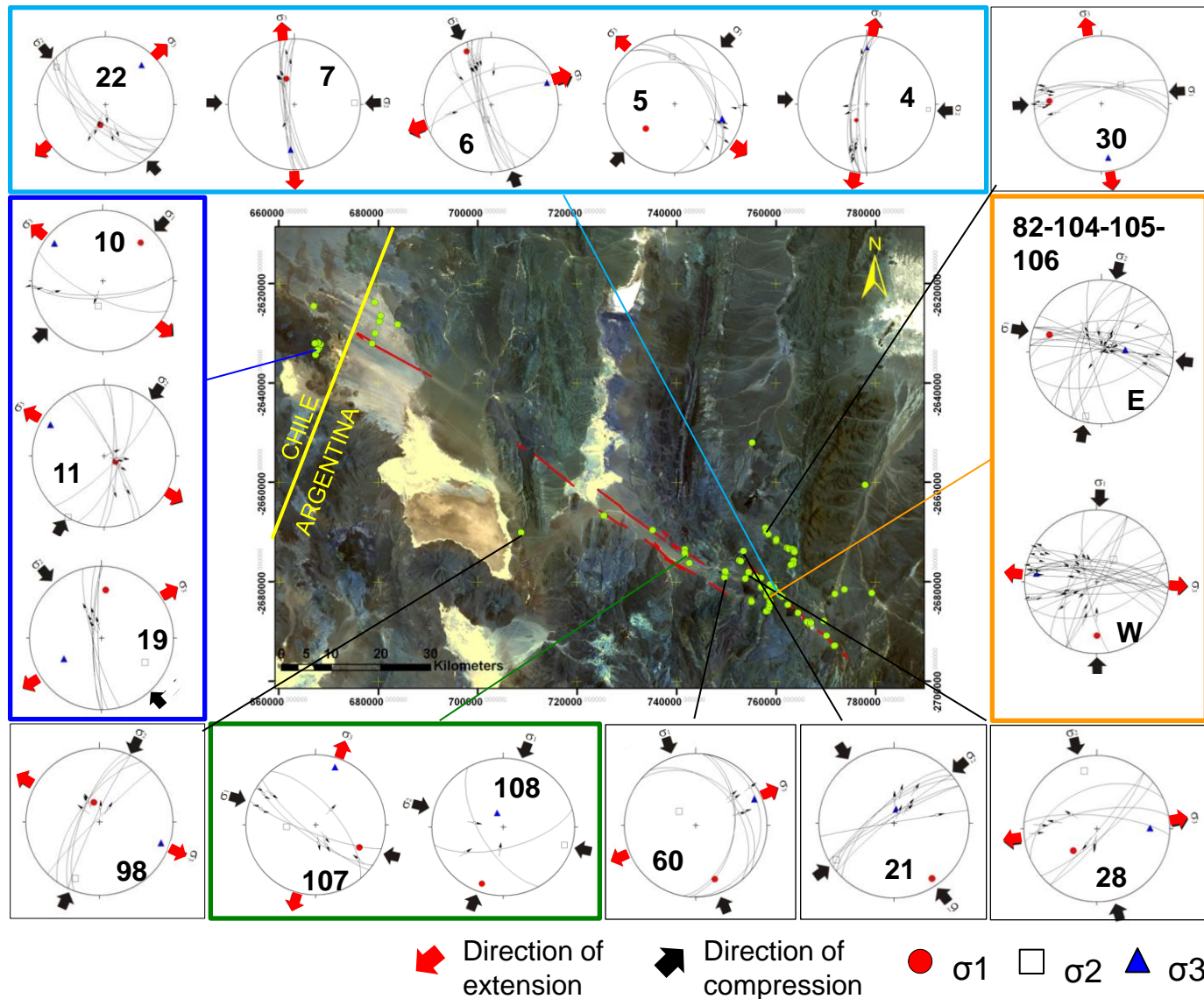




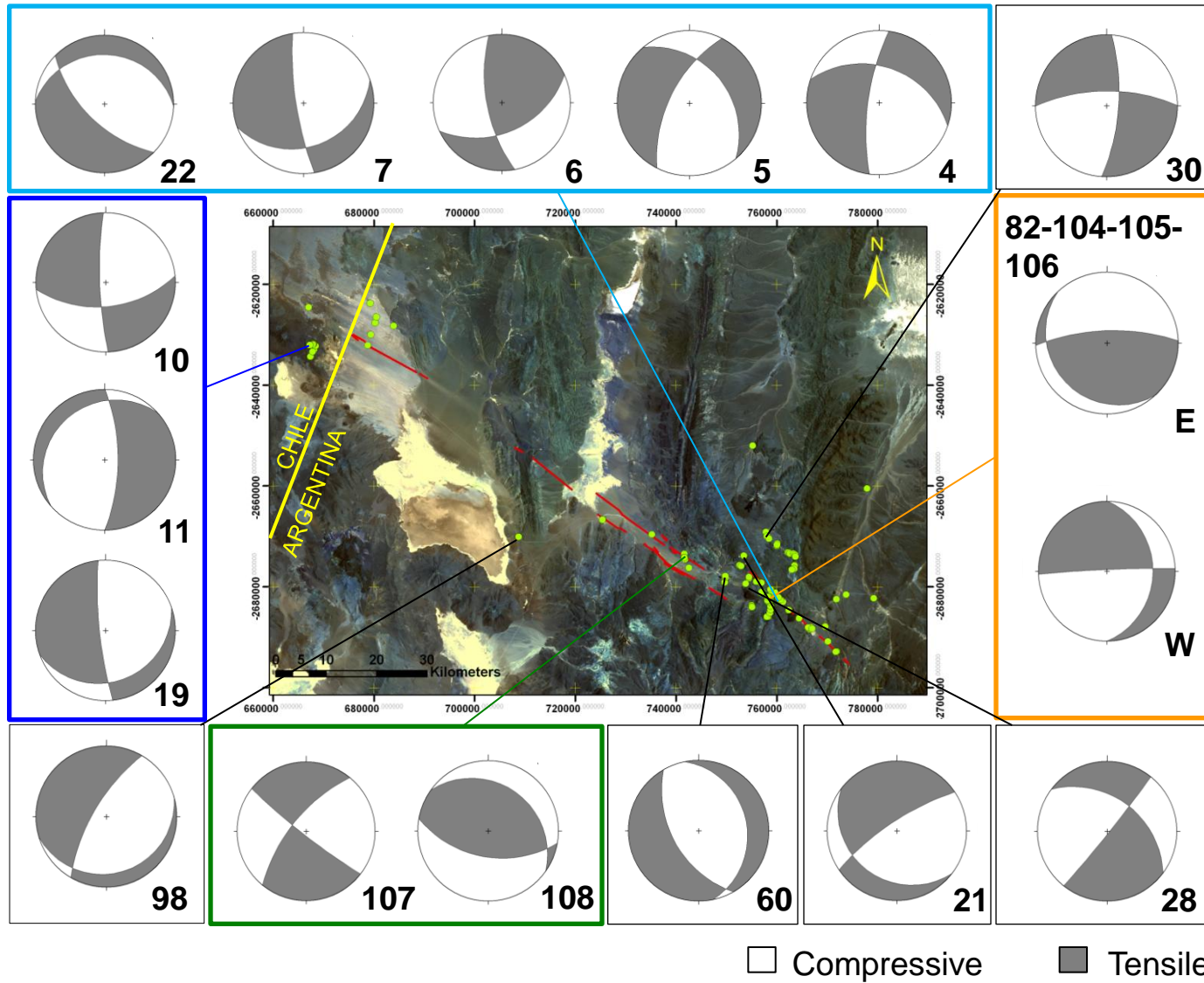
# First Results from Initial Processing: fault geometry as obtained by rose diagrams



# Stress Analysis (I): results from numerical inversion of striated fault planes



## Fault Plane Solutions: Right Dihedra Method of Angelier and Mechler (1977)



## WHAT IS LEFT TO DO

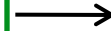
### *Project development*

- Stress Analysis (II)
  - calculation of focal mechanisms in order to compare them to those derived from the inversion of striated fault planes
- Research in seismic catalogs (CERESIS and IRIS) about the seismicity of the area in order to connect faults with recent seismic events and to provide information about the seismic risk of the region
- **Expected date of finishing:** end of this summer (August 26<sup>th</sup> 2011)

## THE OVERALL INVOGE EXPERIENCE

### Coursework and *acquired skills*

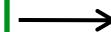
- Volcanology
- Global Geophysics and Geotectonics
- Volcano Seismology (currently enrolled)
- Research project



- How to write a research paper
- How to write a review paper
- Interpret seismic signals from volcanoes, how to use MATLAB

*... and what will happen before I leave for Italy*

- Volcanology Field trip to New Mexico (as Special Topic in Geology)
- IRIS/PASSCAL Instrument Center and EarthScope USArray Array Operations Facility summer student internship at New Mexico Tech.



- Chance to learn physical volcanology and interpret volcano deposits.
- Field methods and seismic data processing

## Highlights

- Unique courses
- Unique opportunities
- Increase effectiveness by different learning approach
- Implementation of new tools
- Improve organizational competence
- Development of personal skills
- Inspiring, creative, and cosmopolitan environment
- American culture

# Questions?



# Thank you!