Synorogenic Basin Evolution

Cordillera Frontal, Argentina

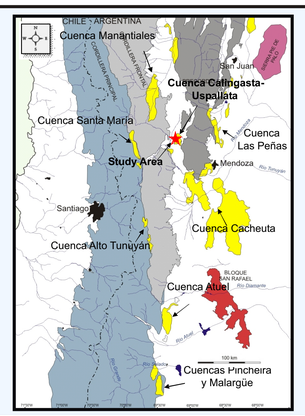
Created by UWEC geologists : Taylor Crist, Michelle Forgette, Bryan Hardel, Phillip Larson, Shane Peterson, Julia Potter, and Heidi Stanek
With fantastic help from our professors: Brian Mahoney, Robert Hooper, and Lori Snyder.

Abstract:

The Argentinian Andes are located in South America between ~ 20°-35°S latitude. The focus area of study is the synorogenic basin development associated with the Aconcagua Fold and Thrust Belt (AFTB). These regions of structurally complex accreted terrains vary in crustal thickness due to the angle of slab subduction. The stress on both rigid and soft material in these formations within the belt generated an excellent area to study the brittle and ductile deformation during denudation processes. Cordillera Frontal uplifted blocks lead to tectonic inversion producing uplift in the west. In the foreland, to the east of the AFTB, a series of basins have resulted from sedimentary erosion and deposition from a variety of provenances. These provenances have been identified by detrital zircon suites collected throughout the Mendoza region. A closer look at zircon analysis reveals a sequence of events that depicts the eastward propagation of the AFTB up to recent time. Age constraints from these zircons illustrate the synorogenic chronology of structural deformation and basin evolution beginning in the early Miocene.

Purpose and Location:

UWEC Geology students and professors traveled to South America to study the evolution of the Argentine Andes. The focus of our study is on recent uplift activity and the development of foreland basins, in particular the development of the Uspallata Basin. The Uspallata Basin is located in the western side of the Mendoza Province and lies between the Cordillera Frontal and the Precordillera.



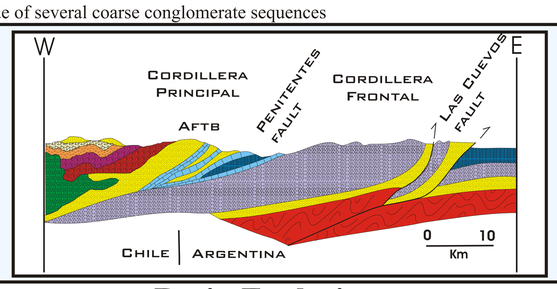
Study Description:

-Miocene basins develop from west to east during eastward progression of thrusting.

-East vergent thrusts ride over earlier developed foreland basins in a multitude of complex thrust sheets.

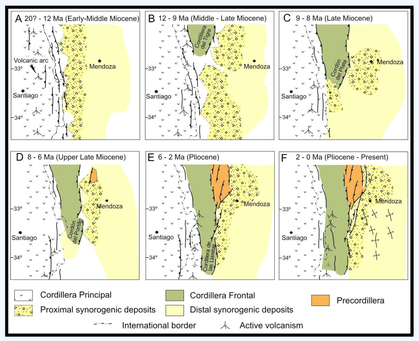
-Detrital zircons in sediments record ages of exposed rocks from source areas

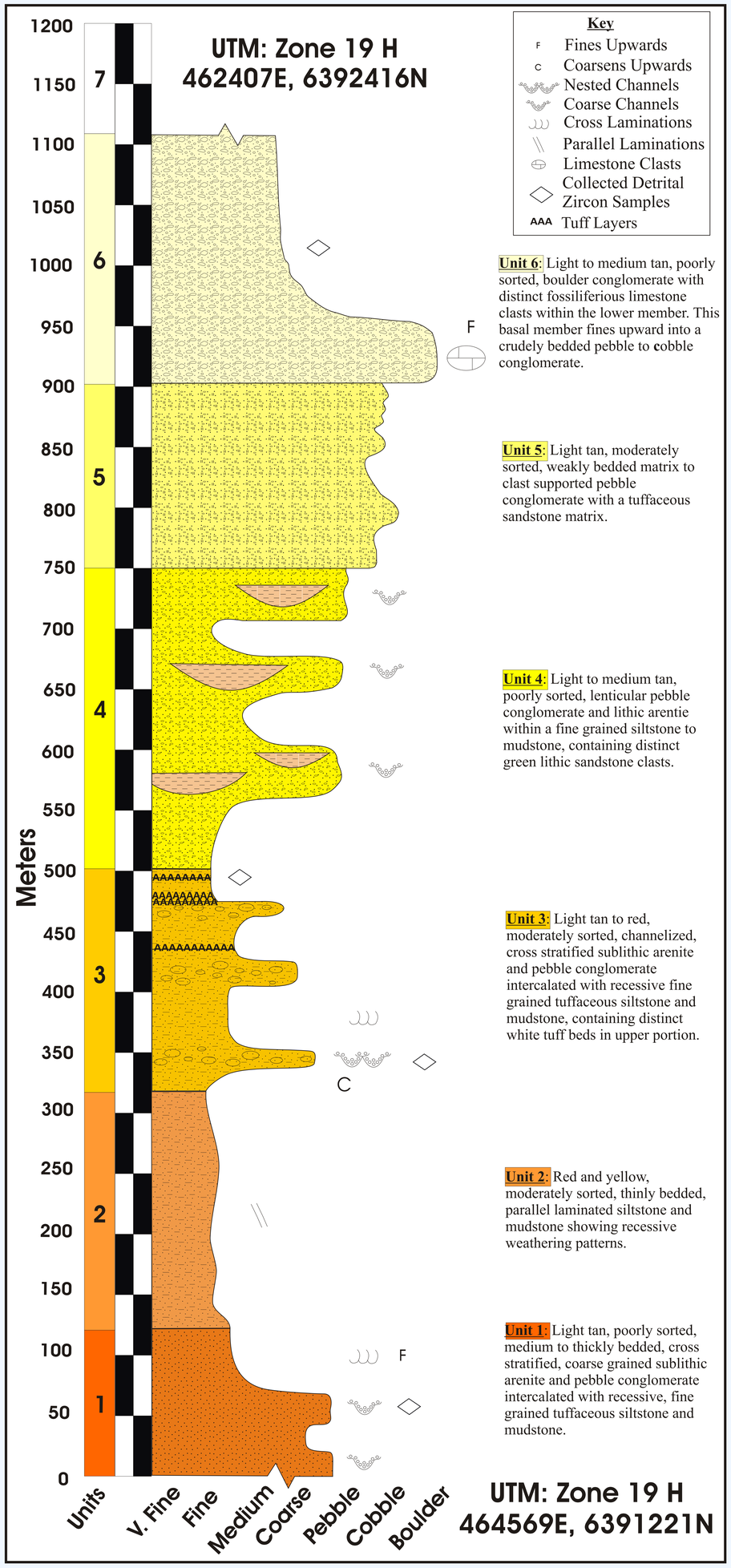
-The Uspallata basin was formed by sagging next to the Cordillera Frontal and is made of several coarse conglomerate sequences



Basin Evolution:

The diagram below illlustrates the formation of synorogenic basins from ~25 Ma to present, leading to the deposition of sediments east of the active subduction margin. This subduction caused west-to-east compression, creating fold and thrust faults which uplifted material and deposited sediment into the nearby Uspallata basin. In figure A, a classic proximal and distal distribution of sediments is deposited into the low lying basin. As thrusting migrates in an eastward direction, shown by the progression of A through F, the proximal sediments also migrate to the east, overlying the previously deposited distal sediments. Proximal deposits are characterized by angular coarse clasts. Distal deposits are characterized by more fine-grained material with more rounded clasts.





Key

- F — Fines Upwards
- C — Coarsens Upwards
- Nested Channels
- Coarse Channels
- Cross Laminations
- Parallel Laminations
- Limestone Clasts
- Collected Detrital Zircon Samples
- AAA — Tuff Layers

Unit 6: Light to medium tan, poorly sorted, boulder conglomerate with distinct fossiliferious limestone clasts within the lower member. This basal member fines upward into a crudely bedded pebble to cobble conglomerate.

Unit 5: Light tan, moderately sorted, weakly bedded matrix to clast supported pebble conglomerate with a tuffaceous sandstone matrix.

Unit 4: Light to medium tan, poorly sorted, lenticular pebble conglomerate and lithic arentie within a fine grained siltstone to mudstone, containing distinct green lithic sandstone clasts.

Unit 3: Light tan to red, moderately sorted, channelized, cross stratified sublithic arenite and pebble conglomerate intercalated with recessive fine grained tuffaceous siltstone and mudstone, containing distinct white tuff beds in upper portion.

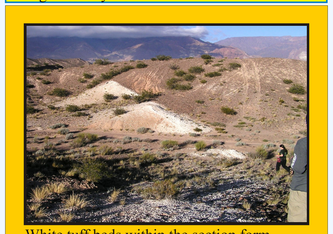
Unit 2: Red and yellow, moderately sorted, thinly bedded, parallel laminated siltstone and mudstone showing recessive weathering patterns.

Unit 1: Light tan, poorly sorted, medium to thickly bedded, cross stratified, coarse grained sublithic arenite and pebble conglomerate intercalated with recessive, fine grained tuffaceous siltstone and mudstone.

Unit 6 records the first influx of boulder-sized clasts into the basin, reflecting a major uplift event within the fold/thrust system.

Sequence of beds throughout a well exposed outcrop in Unit 5.

Interbedded pebble to cobble conglomerate. Note distinct clast alignment, suggesting high velocity flow.



White tuff beds within the section form excellent stratigraphic marker horizons.

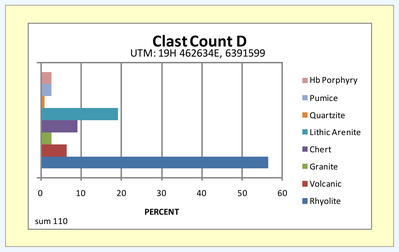
White-weathering volcanic tuff beds near the top of Unit 3. Zircons from this tuff will provide an absolute age of the Uspallata basin.

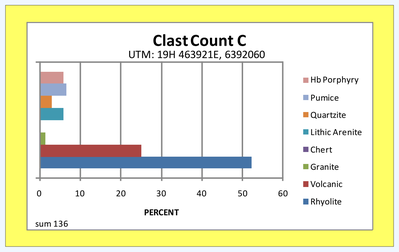
Coarse-grained intervals within recessive weathering fine-grained sediments.

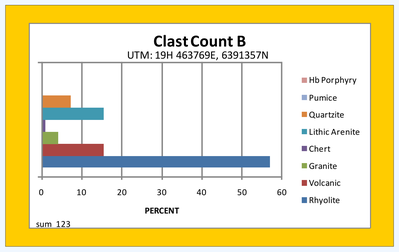
Coarse conglomerate. Note scale.

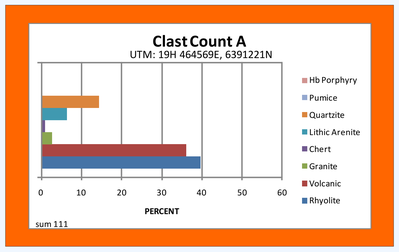
Methods:

Clast counts were taken to describe the variability and composition of the clasts within conglomerate layers. To insure a representative sampling, a one meter string was randomly placed across a well-exposed surface, and each clast along the string was counted and lithologically described (n~100 clasts per count).









Results:

-Rhyolite clasts dominate
-Volcanic clasts generally decrease upward
-Granite clasts remain relatively constant.
-Chert clasts are only significant in unit 6
-Lithic arenite clasts generally increase upward but is variable
-Quartzite clasts decrease upward
-Pumice clasts only evident in top units
-Hornblende porphyry clasts only evident in top units

Summary:

A general coarsening upward trend is observed through the stratigraphic section, which indicates that proximal deposits increase upward. This observation is consistent with an eastward progression of the fold and thrust belt, which is overriding the older basin deposits and shedding proximal sediment over the distal deposits.

Future Work:

-The initial collection of data and compilation of the stratigraphic section constrains deposition within the Uspallata Basin.

-Detrital zircon samples were collected from several locations. Detrital zircon analyses will constrain the evolution of the Uspallata basin through time. Provenance data will provide insight into how the Uspallata Basin developed as the Andes were being formed.

Acknowledgments:

A very special thank you to Victor Ramos and Laura Giambiagi for showing and teaching us the regional geology of Argentina. They are extremely knowledgeable in the geology of the Andes Mountains and supplied detailed basin analysis and regional stratigraphy maps. And lets not forget Stacia Gordon and her love for metamorphic