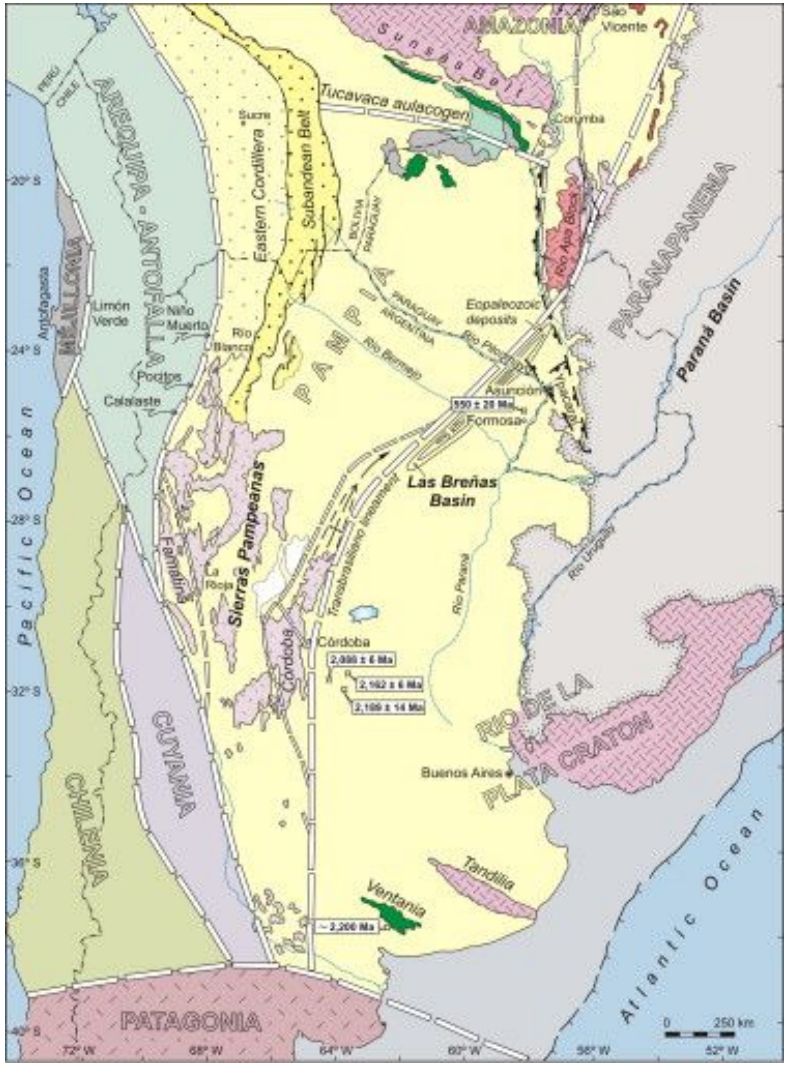
Auxiliar 3: Ciclo Gondwánico

Objetivo de la clase: orientar a los y las estudiantes para el análisis de los papers del ciclo Gondwánico

Geología de Chile - Primavera 2021

REPASO PREVIO...

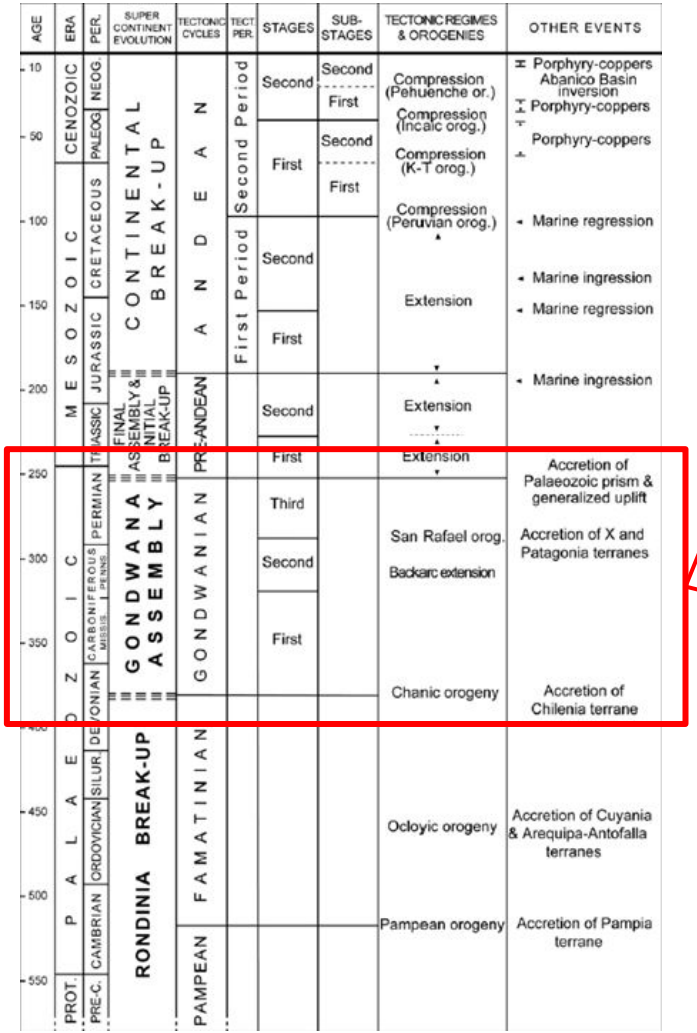
Ciclo Gondwánico

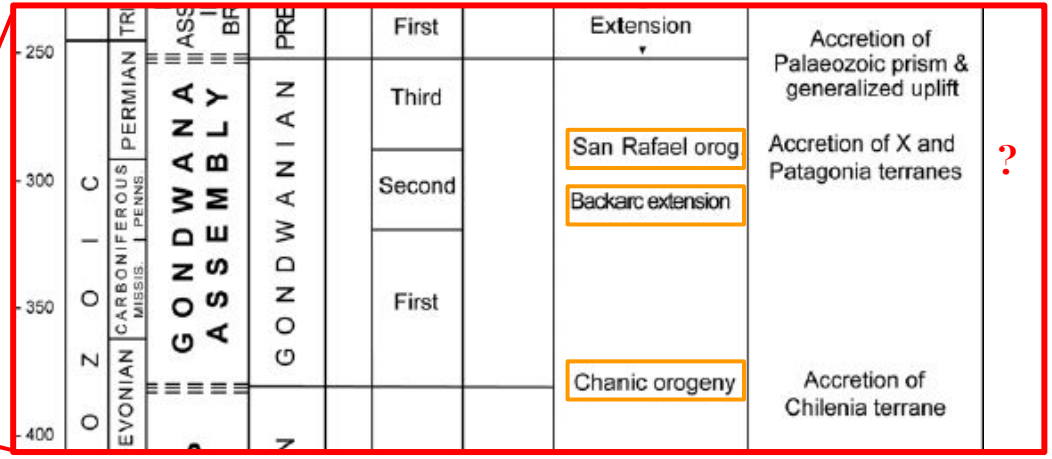


Principales terrenos y cratones de Sudamérica [Ramos et al., 2010]

Claves del Gondwánico

De acuerdo con Charrier et al., 2015



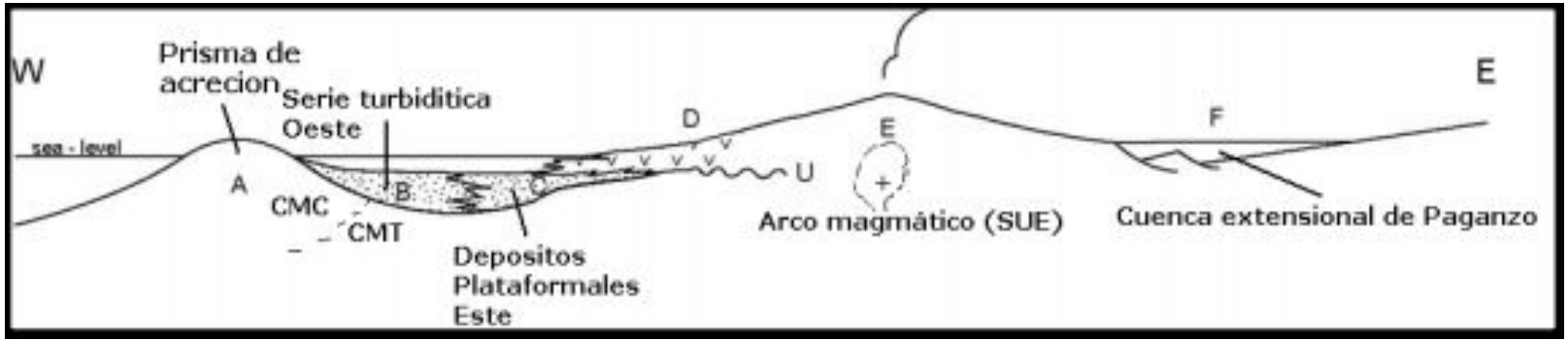


DEVÓNICO SUPERIOR - PÉRMICO SUPERIOR

- Primera etapa: devónico medio- carbonífero temprano
- Segunda etapa: carbonífero tardío- pérmico temprano
- Tercera etapa: pérmico temprano a pérmico medio-tardío

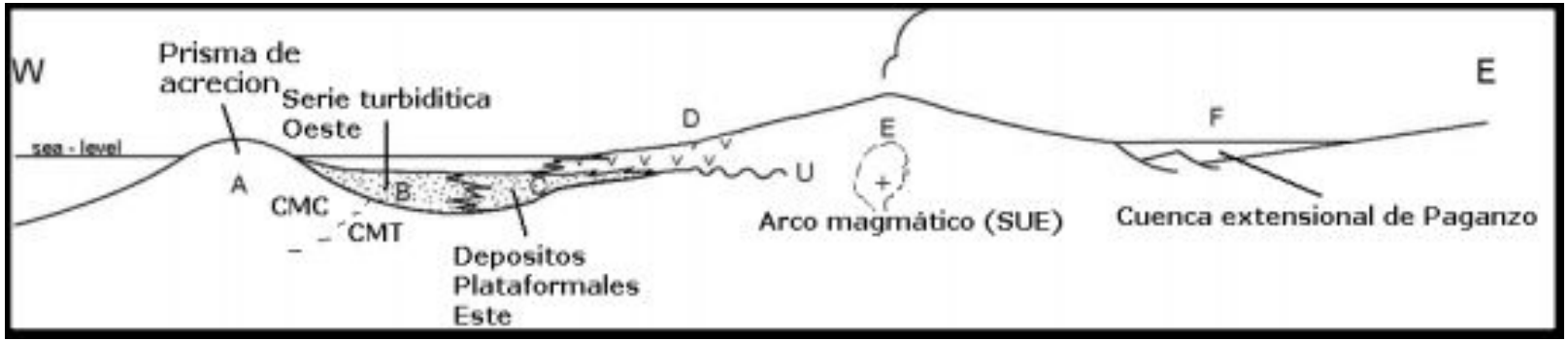
Ciclo Gondwánico

- Primera etapa:
  Inicio con colisión de **Chilenia**
  Evento transgresivo-regresivo⇢ **Al oeste: depósitos turbidíticos**
  Al este: depósitos plataformales



Ciclo Gondwánico

- Segunda etapa:
  Acreción **Complejo Metamórfico del Choapa** (CMC) y **Series E** y **W**
  Actividad magmática de arco↣ **Super Unidad Elqui (SUE), Batolito Costero**



Ciclo Gondwánico

- Tercera etapa: inicia con la **Fase San Rafael**, evento que genera una discordancia

  ⤑ somerización de cuenca plataformal⤑ **Formación Huentelauquén**

GONDWANAN CYCLE

(Mid Devonian – early Late Permian)

Al oeste

Al este

Presencia de plutones

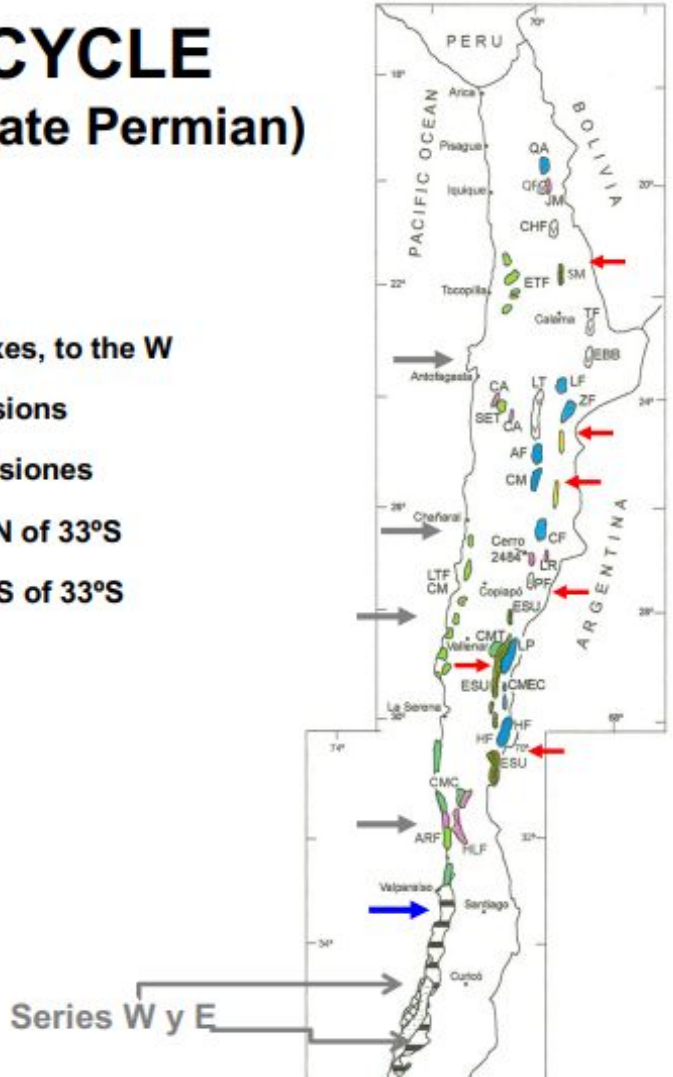
Metamorphic subduction complexes, to the W

Western turbiditic marine successions

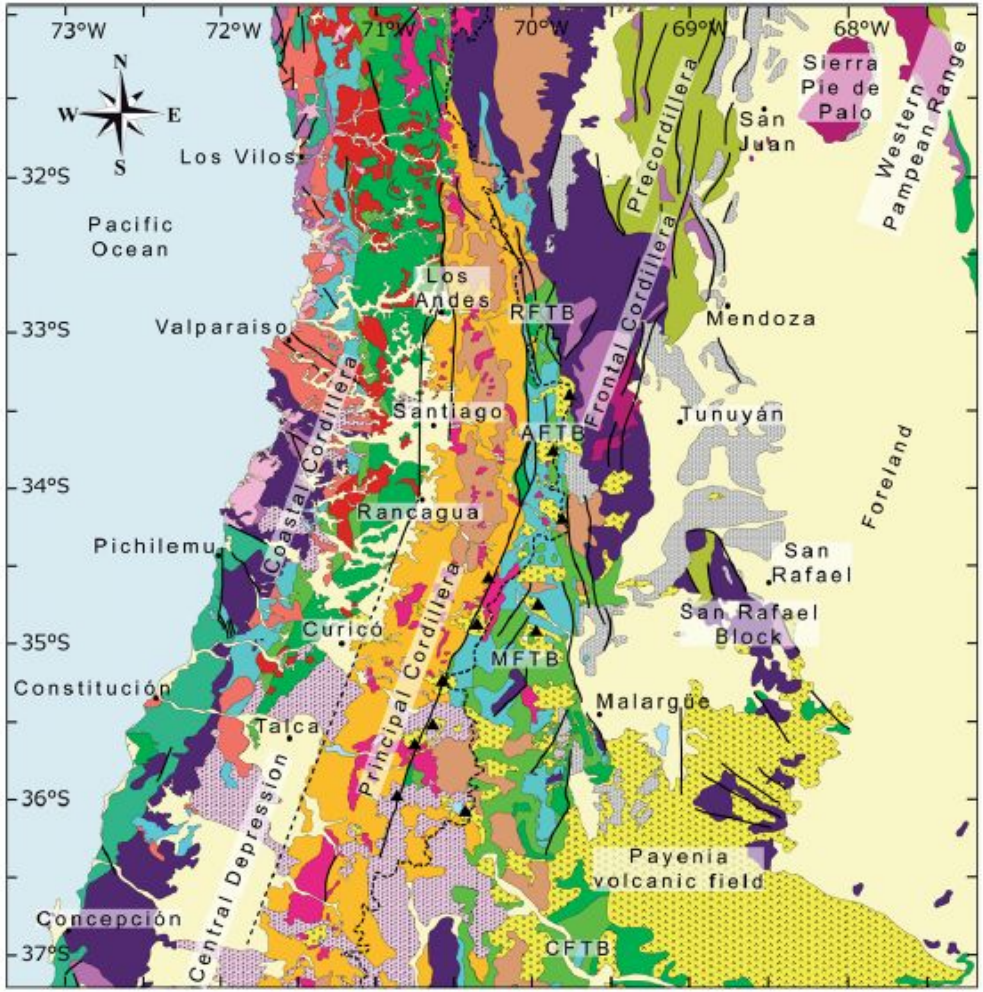
Eastern platformal marine successiones

Plutons in the Frontal Cordillera, N of 33ºS

Plutons in the Coastal Cordillera, S of 33ºS



Series W y E



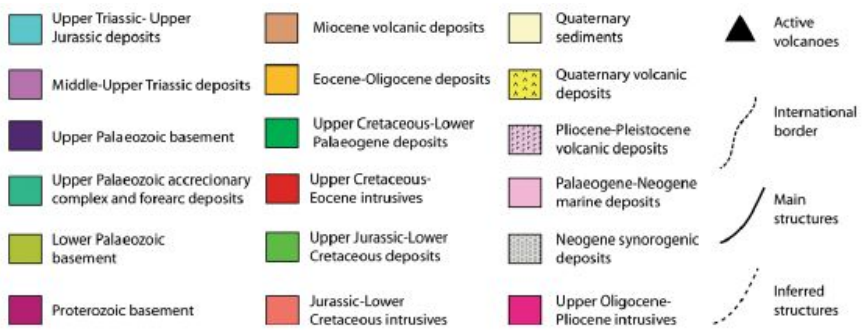


Fig. 3. Geological map of the Andean region between 31 and 37°S. *Abbreviations*: RFTB, Ramada fold-and-thrust belt; AFTB, Aconcagua fold-and-thust belt; MFTB, Malargüe fold-and-thust belt; CFTB, Chos-Malal fold-and-thrust belt.

DEBATE

Separación Batolito Costero y SUE:
¿Terreno X? ¿Zona transcurrente? ¿Plateu?

Charrier et al., 2015

Separación Batolito Costero y SUI: **¿Terreno X? ¿Zona transcurrente? ¿Plateu?**

*Existe evidencia de enclaves graníticos al N de los 33°S, concordantes a la edad del Batolito Costero… Se sugiere una extensión hacia el N del Batolito, bajo la cobertura meso-cenozoica.

¿Margen pasivo al comienzo del Gondwánico?

Desde el Ordovícico Superior al Devónico Superior **no se habían encontrado circones**, por lo que se infería que durante ese período de tiempo, **el margen occidental de Gondwana fue pasivo…**
Pero se han encontrado circones devónicos en otros sitios (S del Perú, Centro-Sur de Chile), lo que podría sugerir que pudo ser un margen transcurrente con zonas de subducción localizadas (?)

¡TRABAJO EN EQUIPOS!

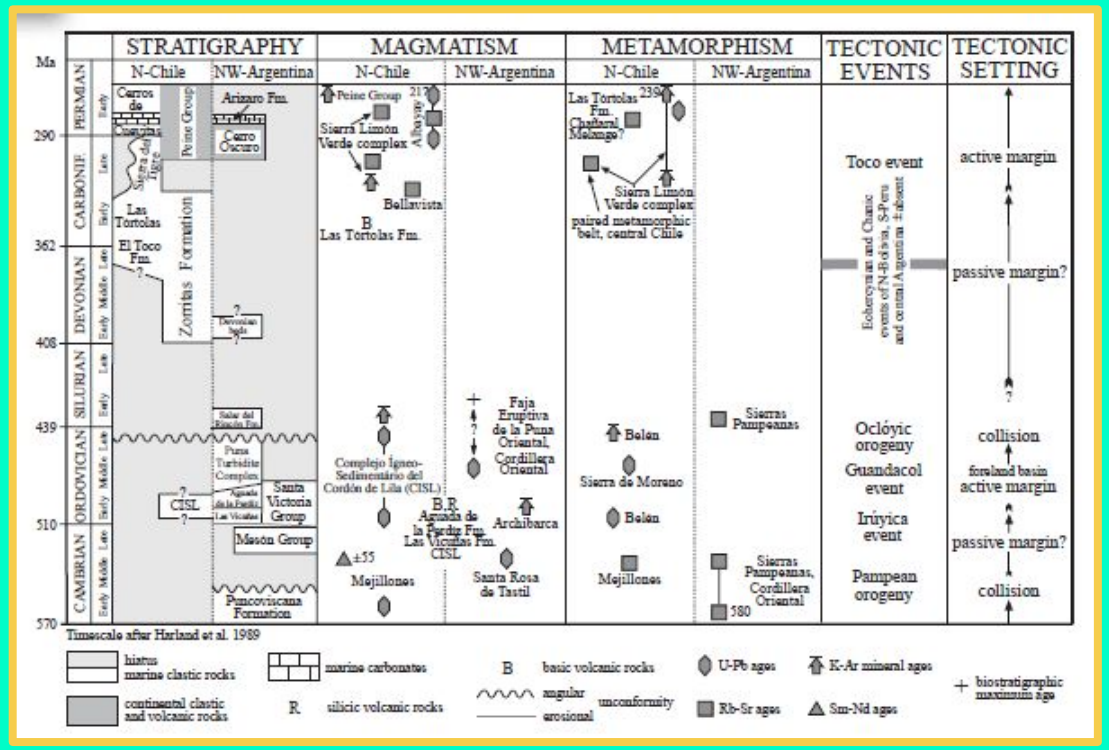
Actividad concentrada entre 19° a 37°S

1. **Crear un cuadro litoestratigráfico de las unidades Gondwánicas. Separar tipos litológicos (sedimentario, metamórfico, metasedimentario, volcánico, metavolcánico, intrusivo, etc…), ubicación relativa al arco, etc…**
2. **En un mapa, ubicar las unidades gondwánicas en Chile, destacando los tipos litoestratigráficos.**

Activity focused between 19° - 37°S

1. **Create a lithostratigraphic chart of the Gondwanic units. Separate lithological types (sedimentary, metamorphic, volcanic, metavolcanic, intrusive, etc.), relative location to the magmatic arc, etc.**
2. **In a map locate the Gondwanic units in Chile, highlighting lithostratigraphic types.**

¡Trabajo en equipos!



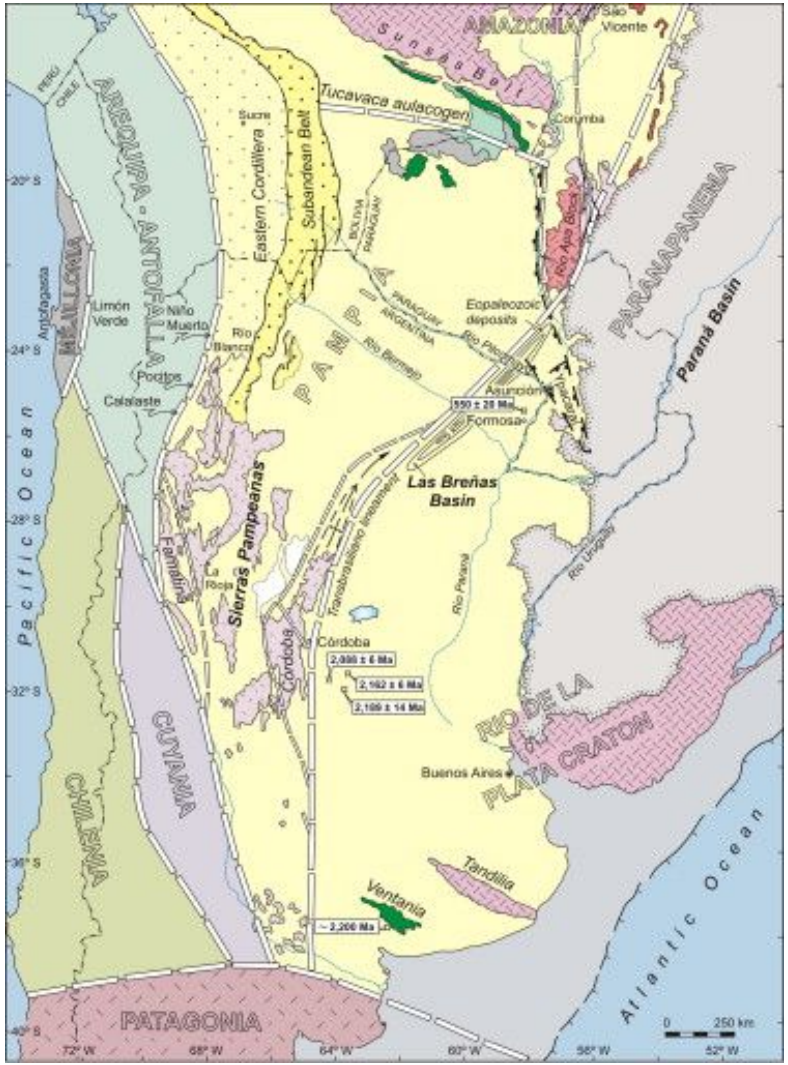
Ejemplo P.1
(sacado de Bahlburg & Hervé, 1997)

Revisemos algunos papers

Los que les servirán para las preguntas 1 y 2 :)

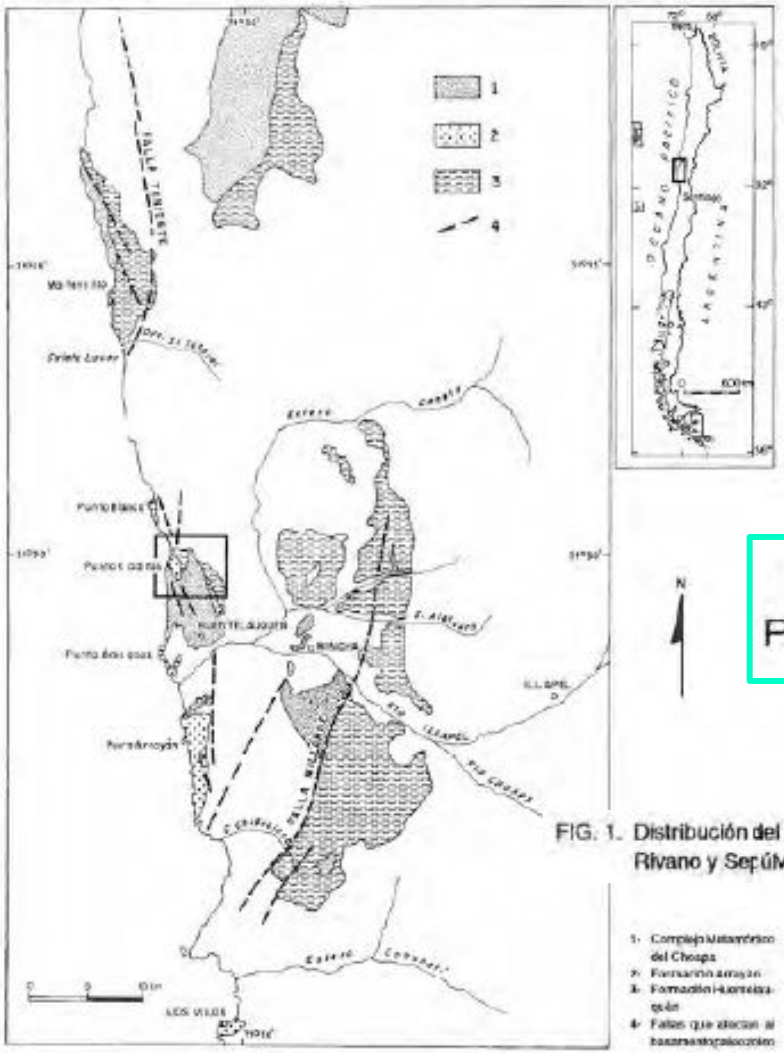
- Rebolledo & Charrier, 1994
- Willner et al., 2011
- Hervé et al., 2013
- García-Sansegundo et al., 2014 (el de Chile)
- Creixell et al., 2021

Lean TODO Creixell et al



Principales terrenos y cratones de Sudamérica [Ramos et al., 2010]

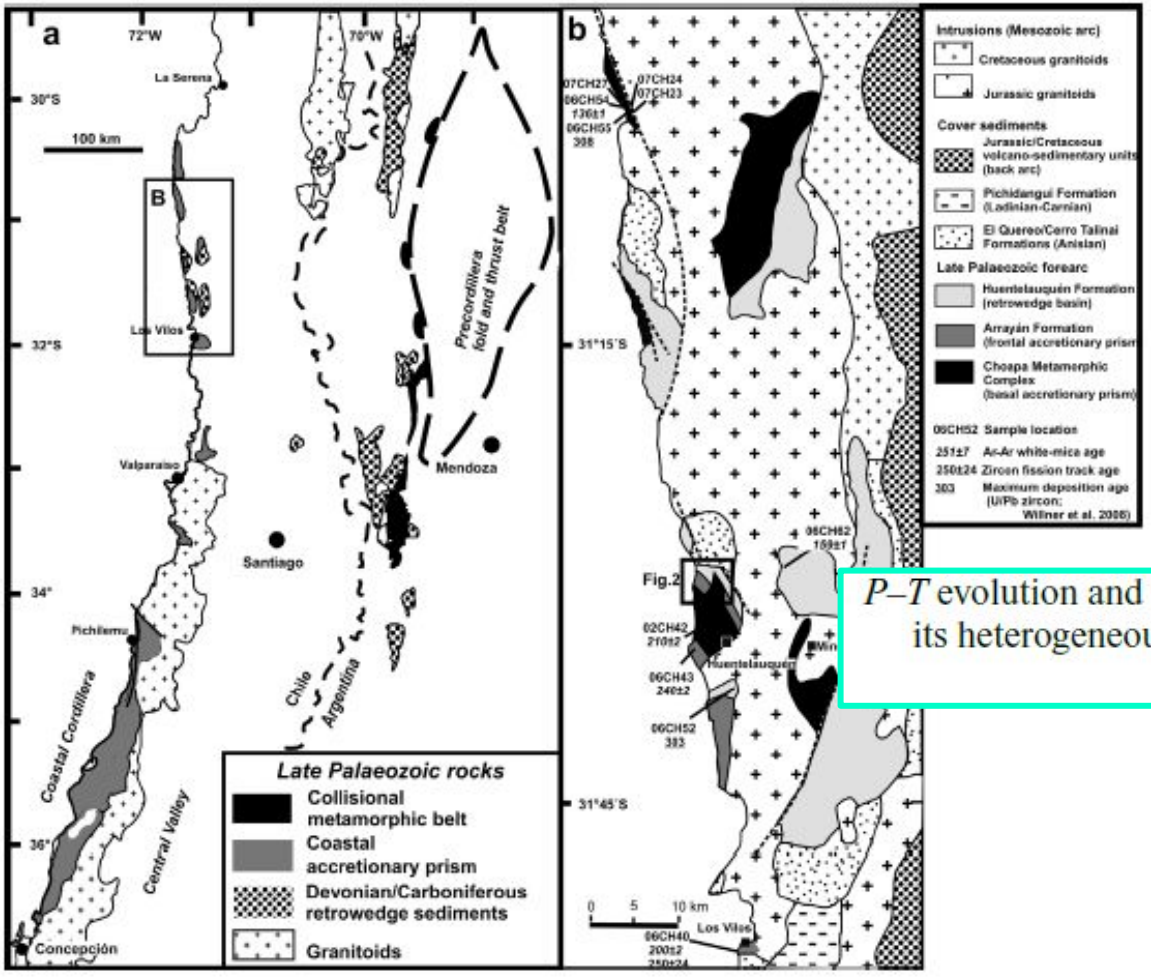
Rebolledo & Charrier, 1994



Evolución del basamento paleozoico en el área de Punta Claditas, Región de Coquimbo, Chile (31-32° S)

FIG. 1. Distribución del basamento paleozoico entre 31° y 32°S y ubicación del área estudiada (tomado de Maass y Roeschmann (1971), Rivano y Sepúlveda (1986) y Rebolledo (1987).

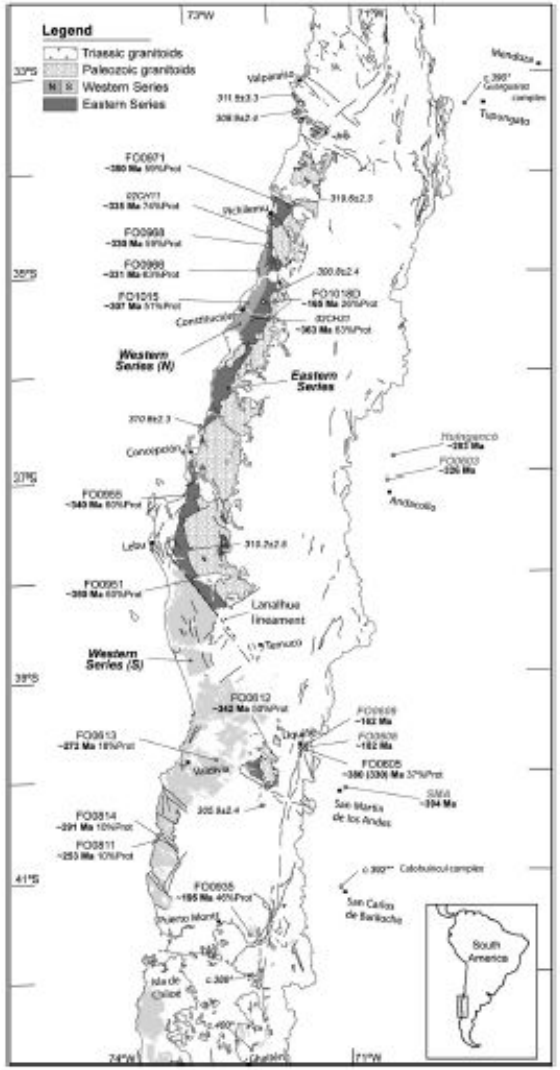
1. Complejo Metamórfico del Choapa
2. Formación Arayán
3. Formación Huentelauquén
4. Fallas que afectan al basamento paleozoico



Willner et al., 2011

P–T evolution and timing of a late Palaeozoic fore-arc system and its heterogeneous Mesozoic overprint in north-central Chile (latitudes 31–32° S)

Figure 1. (a) Compilation of tectonic environments during late Palaeozoic times at lat. 29–37° S after Willner, Gerdes & Massonne (2008). (b) Geological map of the Chilean Coastal Range at lat. 31–32° S after Rivano & Sepúlveda (1983).



Hervé et al., 2013

Provenance variations in the Late Paleozoic accretionary complex of central Chile as indicated by detrital zircons

F. Hervé [a,b,*], M. Calderón [c], C.M. Fanning [d], R.J. Pankhurst [e], E. Godoy [a]

Table 1
Sample localities and descriptions.

	Lat °S	Long °W	Area	Lithology	Comments
Western series					
F00968	34.6890	72.0598	Boyeruca	Banded micaschist	Well developed S_2; S_1 preserved in microlithons. Qtz veins and symmetrical lenses parallel to S_2
F00613	39.8110	72.3039	Antilhue	Micaschist	Qtz-albite composition, banded
F00814			Pucatrihue	Metapsammite	m-thick layer in micaschist with bands parallel to predominant subhorizontal planar S_2
F00811			Maicolpue	Qtz micaschist	Predominant planar s_2 foliation, parallel to lithological banding and quartz veins
F00966	34.9393	72.1846	Iloca	Quartzite	Micaceous, interleaved with albite-bearing quartz micaschists
F01015	35.2622	72.3313	Putu	Psammopelitic schist	With quartz lenses parallel to the main flat-lying s_2 foliation
02CH11	34.5700	72.0680		Metagreywacke	Qtz, Ab, white mica and Chl, recrystallized, with metamorphic banding formed by transposition foliation subparallel to former bedding. Willner et al. (2008)
Eastern Series					
F00971	34.2280	71.9820	Tanume	St metasandstone	Alternates with And-bearing metapelites with Qtz veins parallel to the axial planes of folds
F00955	37.1520	73.1830	Chivilingo	Bt-Ms metasandstone	m-thick beds interleaved with And-bearing metapelites that contain calc-silicate lenses
F00951	38.0270	73.1230	Puren	Bt-Ms metasandstone	Mildly foliated, alternating with metapelites
F00612	39.6759	72.3039	Playa Chaucen	Metasandstone	Alternating with pelite in beds 5–10 cm thick, subvertical stratification
F01018D	35.2630	72.1280	Near Coipue	Metasandstone	Alternates with metapelites, well developed axial planar cleavage and parallel lamination. Mapped as ES (Gana and Hervé, 1983) but has Jurassic detrital zircons
02CH31	35.4180	72.3250		Metagreywacke	Cf. 02CH11 except for Bt grown at the expense of Chl and Kfs due to high-T overprint. Willner et al. (2008)
Liquiñe and Parque Alerce Andino paragneisses, mylonites and plutonic rocks					
F00605	39.7640	71.7810	East of Liquiñe	Bt-Ms banded paragneiss	Tightly folded cm-scale qtz-rich veins
F00606	39.7580	71.8310	Furihuicul 4 bridge	Banded mylonite	Intruded by mafic dykes parallel to the mylonitic foliation, and cut by low-angle faults with a 5 cm-thick gouge. N5E/73 W foliation, with lineations plunging 23°N
F00609	39.7560	71.8310	Furihuicul 2 bridge	Bt-Hbl tonalite	Mylonitized, discrete anastomosing foliation planes separating m-long lenses of less deformed rock, cut by undeformed mafic dykes
F00935	41.5937	72.5943	Parque Alerce Andino	Bt-Ms paragneiss	Coarse-grained, well foliated with planar elongated qtz lenses
Argentina					
F00603	37.0663	70.6489	Cordillera del Viento	White rhyolite	Ore mineralization on fractures. Grupo Andacollo unit of Llambías et al. (2007)
Huingancó			Cordillera del Viento	Bt-perthite granodiorite	Coarse-grained, slightly altered. Huingancó volcano-plutonic complex of Llambías et al. (2007)
SMA			Lago Lacar, SE shore	Bt-Hbl tonalitic gneiss	Coarse-grained, faintly foliated

Mineral abbreviations are: And, andalusite; Bt, biotite; Chl, chlorite; Hbl, hornblende; Kfs, K-feldspar; Ms, muscovite; Qtz, quartz; St, staurolite; Ab, albite.

García-Sansegundo et al., 2014

Structure of the Andean Palaeozoic basement in the Chilean coast at 31º 30′ S: Geodynamic evolution of a subduction margin

J. García-Sansegundo[1*], P. Farias[1], N. Heredia[2], G. Gallastegui[2], R. Charrier[3,4], A. Rubio-Ordóñez[1], A. Cuesta[1]

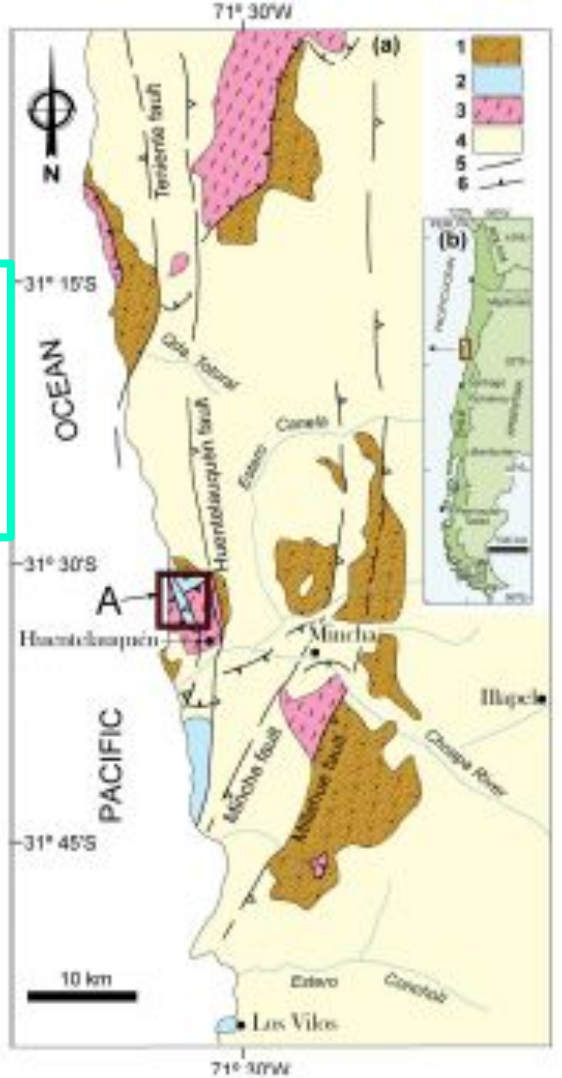


Fig. 1.- (a) Geological map of the Chile coast between 31° 00' and 31° 35' S, based on Rebolledo and Charrier (1994). (A) Location of the geological map of figure 2. (1) Huentelauquén Formation, (2) Arrayán **Formation, (3) Choapa Metamorphic Complex, (4) Meso-**zoic and Cenozoic rocks, (5) fault, (6) thrust. (b) Map of Chile with study area location.

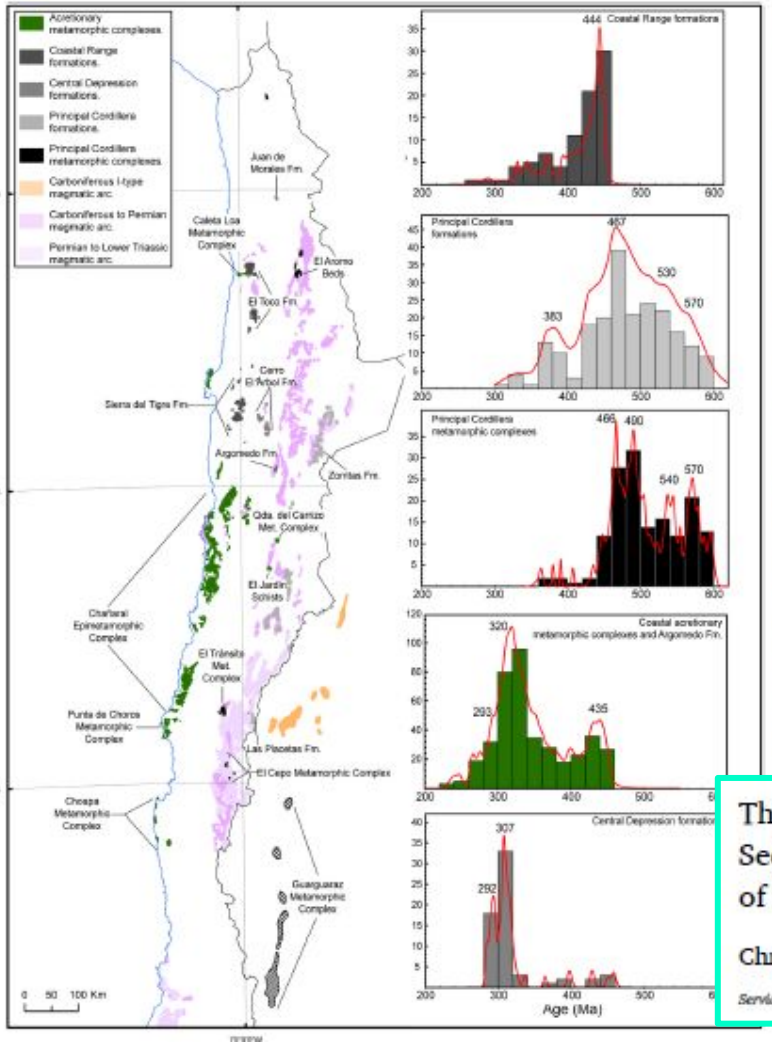


Fig. 2. Geological map showing distribution of Devonian to early Permian rock units analyzed in this study. On the right, statistical distribution of detrital zircon U–Pb ages of each group of rocks. The data sources used in the preparation of these graphs ate the following: Coastal acretionary metamorphic complexes and Argomedo Formation: Caleta Loa Metamorphic Complex (Pankhurst et al., 2016; Vásquez et al., 2018), Chañaral Epimetamorphic Complex (Bahlburg et al., 2009; Escribano et al., 2013; Espinoza et al., 2014; Hervé et al., 2020), Punta de Choros Metamorphic Complex (Bahlburg et al., 2009; Alvarez et al., 2011; Hervé et al., 2020), Choapa Metamorphic Complex (Willner et al., 2008; Álvarez et al., 2011), El Jardín and Quebrada del Carrizo metamorphic complexes (Maksaev et al., 2015), Argomedo Formation (Augustsson et al., 2015; González et al., 2015). Coastal Range formations: El Toco Formation (Bahlburg et al., 2009; Augustsson et al., 2015), Sierra del Tigre Formation (Augustsson et al., 2015; Pankhurst et al., 2016). Central Depression formations: Juan de Morales Formation (Pankhurst et al., 2016), Cerro El Árbol Formation (Astudillo et al., 2017). Main Cordillera formations: Zorritas Formation (Augustsson et al., 2015; Villa et al., 2019), Las Placetas Formation (Ortiz y Merino, 2015; Salazar y Coloma, 2016). Main Cordillera metamorphic complexes: El Aromo Beds (Aguilef et al., 2020), El Tránsito Metamorphic Complex (Alvarez et al., 2011), El Cepo Metamorphic Complex (Ortiz y Merino, 2015; Murillo et al., 2017).

Creixell et al., 2021

The Carboniferous onset of subduction at SW Gondwana revisited: Sedimentation and deformation processes along the late Paleozoic forearc of north Chile (21°–33° S)

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¡TRABAJO EN EQUIPOS! (PARTE 2)

Siguiente clase auxiliar:

1. **Indicar el peak metamórfico de cada Complejo Metamórfico, así como su evolución PTt en el caso que exista esta información**
2. **Determinar si el complejo metamórfico específico corresponde a un prisma de acreción (frontal, basal), o si su metamorfismo está relacionado a la actividad del magma (considere que hay complejos que atravesaron distintas etapas de desarrollo).**

Next auxiliary class:

1. **Indicate the metamorphic peak for each Metamorphic Complex, also their PTt evolution if there is any information.**
2. **Determinate if the specific Methamorphic Complex correpsonds to an accretion wedge (frontal, basal) or if its metamorphism is related with magmatic activity (considering that there are complexes that crossed different development stages).**