STRUCTURAL FRAMEWORK AND EVOLUTION OF THE GOLFO SAN JORGE BASIN: A SYNTHESIS

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ABSTRACT

The Golfo San Jorge Basin evolved through a complex multiphase structural history from the Middle Jurassic to the Neogene. Its stratigraphic record captures key tectonic events in central extra-Andean Patagonia during Gondwana fragmentation and the Andes construction, allowing us to refine and calibrate multiscale structural processes associated with extension and positive tectonic inversion. The structural architecture reflects the interplay of upper-crustal remote stress, active basement structures, coaxial and non-coaxial extensional reactivations, short-wavelength tectonic inversion, thermal subsidence, and mantle processes. A comprehensive understanding of these interactions is crucial for improving regional basin models with broader implications for tectonic and petroleum system studies.

INTRODUCTION

Since its discovery in 1907, hydrocarbon production in the Golfo San Jorge Basin (GSJB, Fig. 1) has driven significant advances in various geological disciplines, although structural geology studies remain relatively scarce. Traditionally, the GSJB is regarded as a rift basin formed in relation to the opening of the Atlantic Ocean during Gondwana fragmentation, and later modified by superimposed contractional deformation associated with the development of the Andes Cordillera to the west.

Structurally, the GSJB displays an east–west trend of maximum elongation and a high width-to-length ratio, a configuration that diverges from that of classical narrow rift basins and underscores the potential importance of regional thermal subsidence (Kusznir *et al.*, 2002). The basin also contains a north–south–trending intrabasinal contractional fold belt known as the San Bernardo Fold Belt, located distally with respect to the Andes. The selective positive tectonic inversion of this fold belt provides an opportunity to evaluate the structural controls involved in the reverse reactivation of extensional fault systems.

This contribution reviews the current state of structural knowledge in the GSJB, assesses the strengths and limitations of existing geological models, and proposes directions for future research.

TECTONOSTRATIGRAPHIC FRAMEWORK

The Golfo San Jorge Basin (GSJB) is located in central Patagonia, and it is characterized by a polyphase evolutionary history evident in its sedimentary record. The structural basement is composed of Paleozoic igneous-metamorphic rocks, whereas the prerift succession comprises the sedimentary units of the Tepuel Group (Carboniferous-Permian) and marine Liassic deposits (Fig. 1a). The Mesozoic extensional evolution of the basin was linked to the opening of the South Atlantic Ocean, giving rise to a multiphase rifting scenario. The first extensional phase (E1, Fig. 2) is represented by thick volcanic and volcaniclastic successions of Middle to Upper Jurassic age (Navarrete, 2025). These successions are often considered part of the economic basement, which has led to an underestimation of their influence on subsequent depocenter development (Fig. 1b).

During the latest Jurassic to earliest Cretaceous, some of these long-lived half-grabens were reactivated during a second extensional phase (E2, Fig. 2). These depocenters were infilled by epiclastic successions informally assigned to the "Neocomian" cycle, reaching several kilometers in thickness (Fitzgerald *et al.*, 1990; Fig. 2). This non-volcanic extensional climax produced an underfilled stage characterized by isolated to partially connected depocenters, in which the black shales of the Pozo Anticlinal Aguada Bandera Formation were deposited. These starved basins evolved into an overfilled stage associated with the late synrift of E2, preserved in the Pozo Cerro Guadal Formation. Above these successions lies the Chubut Group (or "Chubutian" cycle), comprising continental deposits that can exceed 6000 m in thickness within the deepest depocenters. The vertical succession of the Chubut Group comprises at least four discrete continental sedimentary systems: Pozo D-129 and Matasiete, Pozo D-129 and Castillo, Bajo Barreal, and Laguna Palacios–Lago Colhué Huapi, along with their subsurface equivalents (Paredes *et al.*, 2021).

In terms of larger-scale tectonostratigraphic architecture, the Chubut Group displays a regional sedimentary pattern extending beyond the areas affected by the E2 phase, with a significant phase of extensional reactivation (E3, Fig. 2) during deposition of the lacustrine Pozo D-129 Formation (Figari *et al.*, 1999; Sylwan *et al.*, 2011). The structural framework throughout the Upper Cretaceous remains a matter of debate, primarily due to uncertainties surrounding the tectonostratigraphic context of coeval lithostratigraphic units. Traditionally, Upper Cretaceous strata are considered part of a regional subsidence regime associated with a postrift setting, punctuated by subordinate intraformational normal faulting (Sylwan *et al.*, 2011). However, more recent studies propose a compressional setting during this interval (Allard *et al.*, 2021; Gianni *et al.*, 2021; Ramos, 2021).

Finally, the basin contains a substantial Cenozoic record composed of multiple Atlantic transgression–regression cycles accompanied by variable retroarc basaltic activity (Foix *et al.*, 2021; Haller *et al.*, 2021). During this stage, the basin can be divided into eastern and western domains, reflecting a passive margin configuration to the east and a broken foreland setting to the west (Bilmes *et al.*, 2021).

STRUCTURAL REGIONS

According to Figari *et al.* (1999), the GSJB can be subdivided into six structural domains based on the current tectonic style and the structural trends affecting its sedimentary record. Although this framework is widely adopted, Figure 1 highlights how the contractional front is refined by the eastward-inverted structures.

North Flank

This domain is characterized by a shallow crystalline basement, correlated with outcropping Permian granitoids, which forms a southward-plunging paleohigh (Allard *et al.*, 2020). Overlying this basement are discontinuous Liassic deposits that are notably thinner than in other adjacent regions. The prerift seismic architecture is interpreted as a folded extensional record, although additional well calibration and deeper stratigraphic marker analysis are needed for a more constrained interpretation (Allard *et al.*, 2021).

The boundary between the North Flank and the San Bernardo Fold Belt is well documented in the Cerro Dragón oilfield. In this area, the Valle Hermoso lineament defines a discrete NNW–SSE boundary separating a domain of inverted faults from a domain of E–W normal faults characterized by NW– and

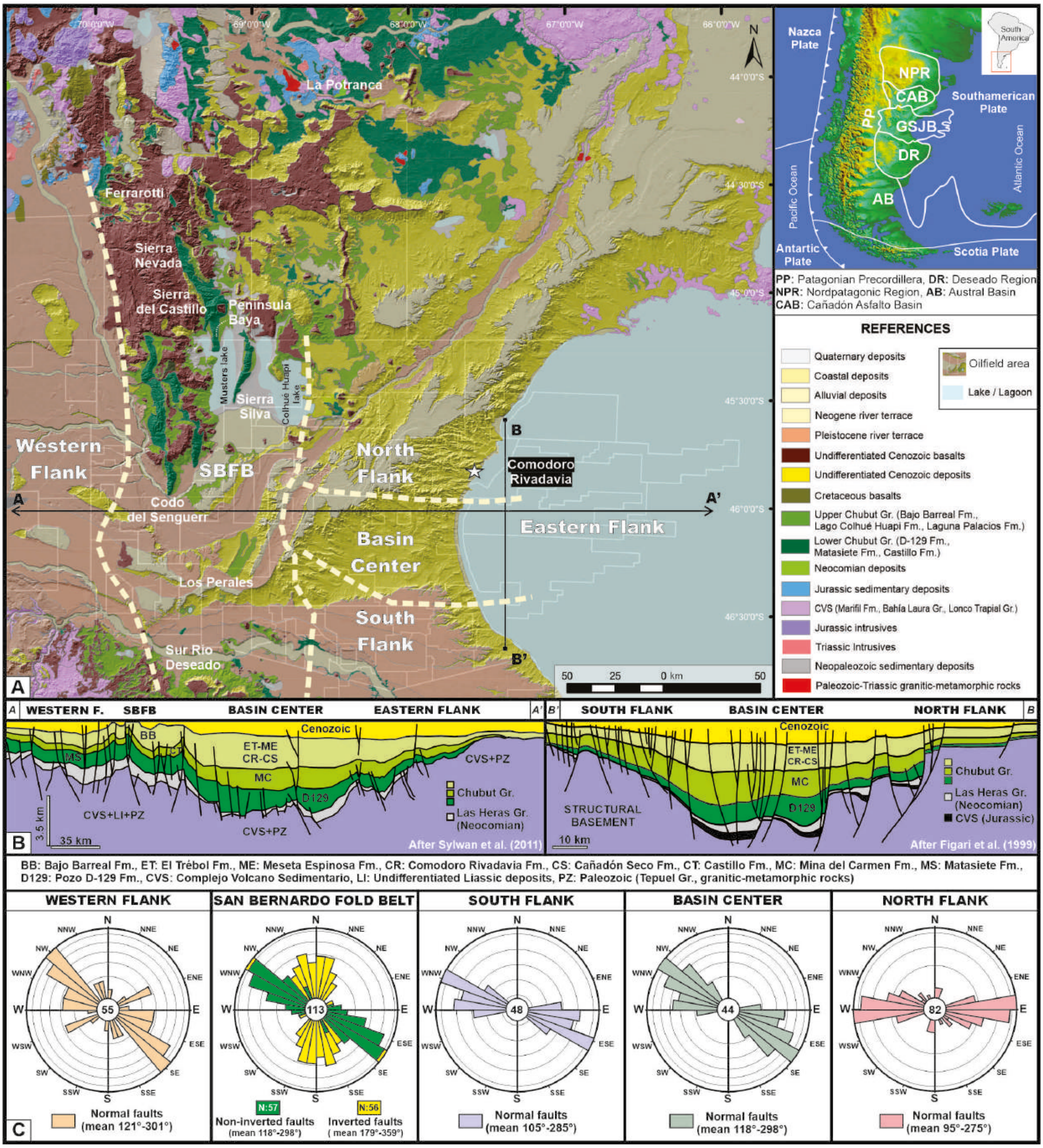

Figure 1. a) Simplified geological map showing the main structural domains and adjacent geological provinces. Note that the San Bernardo Fold Belt (SBFB) can be divided into an outcropped subregion to the north and a subsurface subregion to the south. **b)** Regional structural cross-sections illustrating the large-scale thickness and distribution of the sedimentary record. **c)** Distribution of fault strikes across different regions; the fault traces are referenced to the Castillo Formation depth, following Figari *et al.* (1999).

SW–trending en echelon segments (Cohen *et al.*, 2021). East of the North Flank, E–W normal faulting prevails, exemplified by the Escalante fault system, which locally shifts to a NW–SE orientation at the El Alba fault system and the Voster High (Giampaoli, 2019). The correlation of this NW–SE trend with the strong NNW metamorphic fabric exposed in the La Potranca block (Giacosa, 2020) suggests an active basement fabric that exerts regional control on the 3D fault architecture.

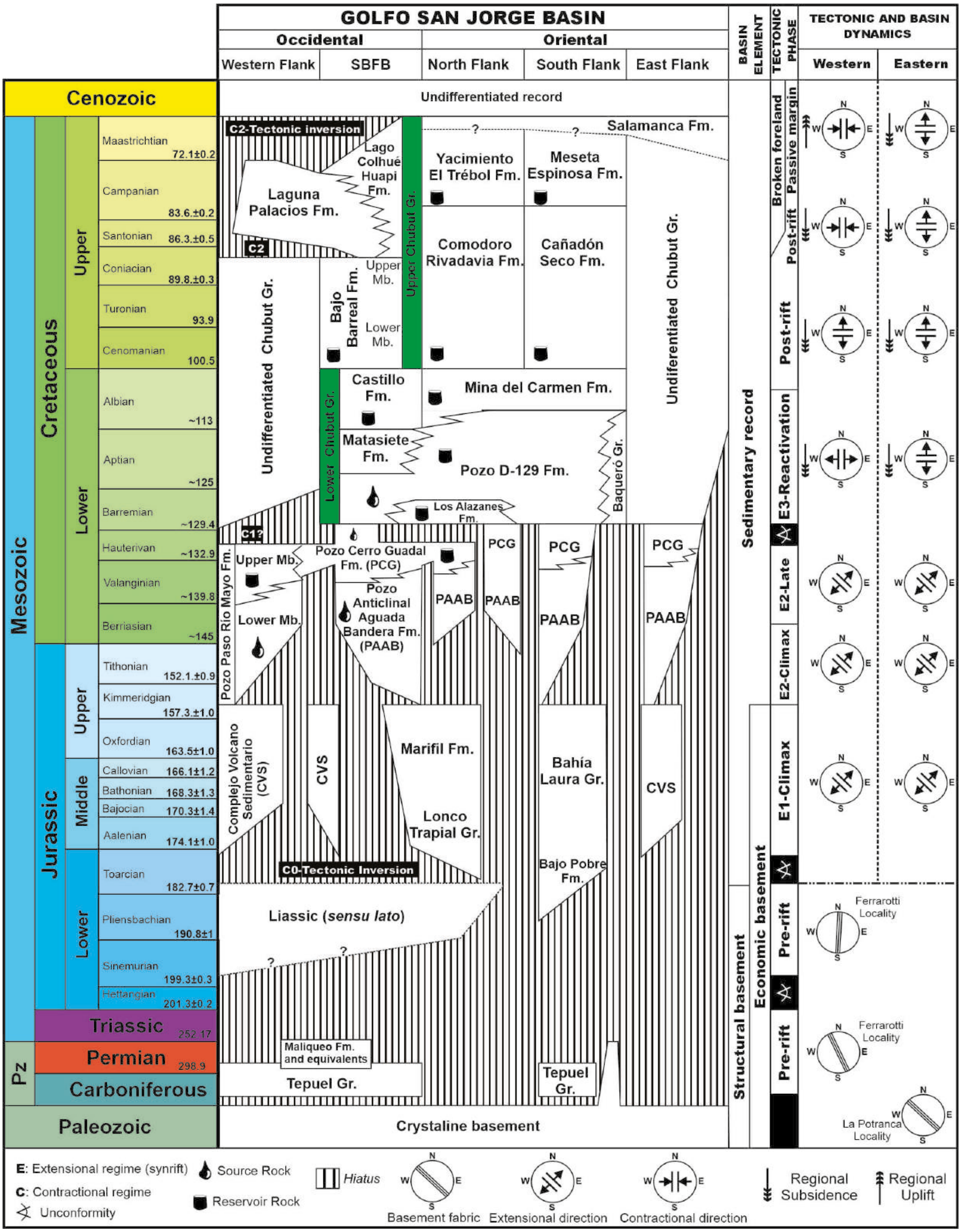

Figure 2. Tectonostratigraphic chart of the different structural regions of the Golfo San Jorge Basin. Modified from Allard *et al.* (2021). The tectonic and basin dynamics setting is based on the present contribution.

This deep structural fabric governed multiple episodes of Cretaceous extension, with a climax during the “Neocomian” cycle and later reactivating to partially induce connected or decoupled intraformational faults during deposition of the Pozo D-129 and Mina del Carmen formations (Fig. 3). Oblique rifting typifies the Lower Cretaceous successions, while the Upper Cretaceous deposits display echelon minor faults that mimic the oblique basement structures. Changes in major fault strikes through stratigraphic sections, as noted by Paredes *et al.* (2013), support a clockwise rotation of the maximum principal stress over time. Paleostress analyses based on outcropped mesostructures show a NE–SW extensional regime during the Paleogene (Foix *et al.*, 2012), which shifted to a NNW–SSE extensional regime during the Neogene (Oporto Romero *et al.*, 2023). Seismic analysis of Neogene dikes indicates a polymodal strike distribution (primarily NNW and NNE), implying an E–W extension direction during their emplacement (Plazibat *et al.*, 2019).

Basin Center

This region exhibits the greatest overall sedimentary thickness, although this pattern is largely confined to the Chubut Group and overlying Cenozoic deposits. In contrast, the earlier “Neocomian” cycle occurs in offset, partly isolated depocenters along the Western Flank and the southernmost extent of the San Bernardo Fold Belt, most notably the Sur Río Deseado Depocenter, which reaches ~4500 m (Fitzgerald *et al.*, 1990). This tectonostratigraphic architecture indicates first-order shifts in basin configuration, driven by thermal regional subsidence that resulted in basinward tilting of the strata.

At the Mina del Carmen level, the structural framework is dominated by NW–SE normal faults, which represent some of the basin’s longest fault traces (Figari *et al.*, 1999; Ramos, 2021). Although these fault traces imply significant basement faulting, structural cross sections reveal only subtle throws throughout the stratigraphic column, with no substantial “Neocomian” depocenters (Figari *et al.*, 1999). Moreover, fault density is notably lower than that observed in the North and South flanks. Collectively, these geometric features suggest a bias in structural mapping toward intra-Chubut Group fault systems, while basement-related fault arrays remain underexplored, largely due to limited economic interest. Additional research is thus required to elucidate the underlying mechanisms of subsidence, particularly through distinguishing the respective influences of thermal and mechanical processes.

A significant event recorded in this region is the latest Cretaceous Atlantic transgression, whose timing and controlling mechanisms remain poorly understood (Barcat *et al.*, 1989; Paredes *et al.*, 2025. The regional depression and east–west structural corridors likely influenced the transition from an endorheic to an exoreic basin, a process that may have been diachronous during its initial stages.

South Flank

This region lies within Santa Cruz Province, where the deep structural framework is primarily defined by NW–SE to NE–SW basement faults controlling the synrift climax sequences of the Jurassic to Lower Cretaceous (Fitzgerald *et al.*, 1990; Paredes *et al.*, 2018). Their non-parallel geometry indicates an active basement fabric, particularly in areas where stratified basement reach thicknesses of up to approximately 1 second two-way travel time (TWT). This fault pattern contrasts with the structural style of the Chubut Group, which is dominated by a bimodal set of normal faults-oriented E–W and ESE–WNW, coupled with a predominant northward dip direction (Figari *et al.*, 1999; Ramos, 2021).

Earlier interpretations attributed this transition in fault orientations to a megasequence boundary. However, recent work demonstrates that certain major depocenters display conformable relationships among these seismosequences, grading laterally into minor unconformities linked to the rotation of flexural margins in active half-grabens (Paredes *et al.*, 2018, 2021). During the Cenozoic, fault strikes revert to NW–SE, with a newly observed NNW–SSE trend that partially overlaps with the NNW–SSE to NNE–SSW basaltic dike swarms associated with multiple Cenozoic igneous events. Seismic-scale data support that these dikes intruded the sedimentary cover without significant dip-slip motion, indicating tensional Type 1 fracturing.

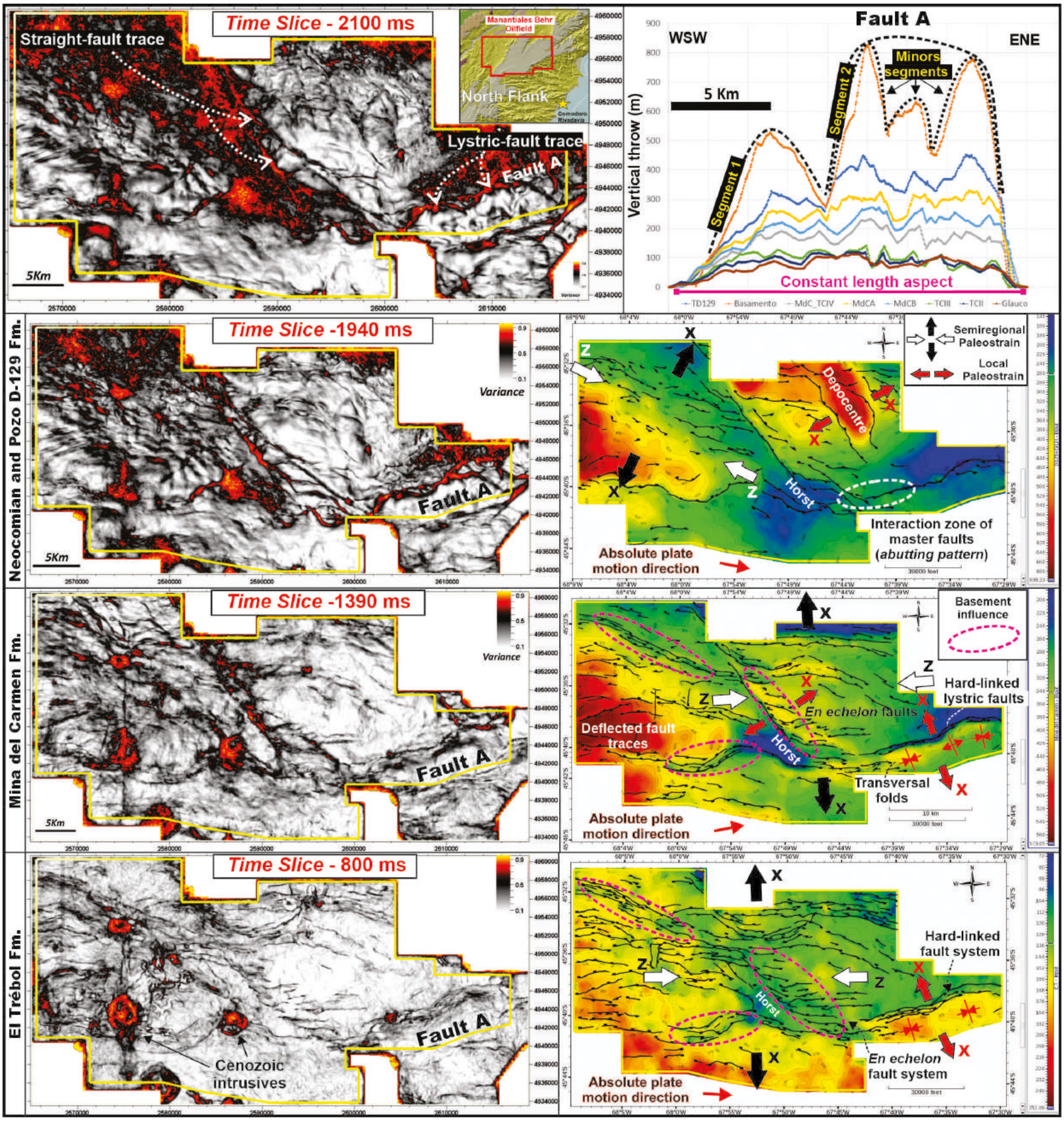

Figure 3. Structural architecture of the Manantiales Behr oilfield in the Voster Horst region, interpreted using time-slice analysis, isochronopach maps, and throw profiles. Note that the cover fault systems mimic the underlying NW-trending basement faults. Absolute plate motion direction based on Müller *et al.* (2016). Keys: Maximum Shortening (Z) and Maximum Stretching (X) directions. Modified from Guerra *et al.* (2019).

Eastern Flank

Although only a limited number of wells have been drilled in this region—primarily owing to its low hydrocarbon potential—key features here nonetheless contribute to a more comprehensive understanding of basin architecture. Offshore, the structural framework appears to extend the onshore normal faults, with the basement rocks gradually shallowing toward the east to form a threshold against the continental talus (Fig. 1b). Overall, the structural array follows an E–W trend, with some faults deflecting toward NE–SW (Figari *et al.*, 2021). Master faults commonly nucleate secondary structures affecting both the "Chubutian" cycle and the overlying Cenozoic seismic sequences.

Recent seismic interpretations highlight deep, narrow, and thick extensional depocenters with a predominantly N–S orientation; their fill is inferred to be Upper Jurassic to "Neocomian" by analogy with nearby onshore analogues (Allard *et al.*, 2021). At the basin scale, this flank occupies a meridional position similar to that of the inverted San Julián Basin (Homovc and Constantini, 2001). However, evidence of inversion here is either absent or poorly constrained, emphasizing the need for tectonic models that explain how far-field stress was efficiently transmitted through this region while largely bypassing the non-inverted North and South flanks.

San Bernardo Fold Belt

This contractional domain is defined by a fold belt comprising NNW– to NNE–trending, subparallel folds that extend for tens of kilometers and lack a clear vergence, creating an accordion-like pattern. This geometry reflects the thick-skinned character of deformation, associated with inverted extensional faults. Nearly all exposed folds exhibit axial interruptions caused by WSW– to WNW–oriented lower-order faults showing either abutment or cross-cut relationships (Fig. 4a). Such fault–fold interactions, together with the lateral shifting of individual fold segments, have been interpreted by some authors as indicative of regional strike-slip fault systems linked to discrete, deep-seated fabrics (Barcat *et al.*, 1989).

South of the Codo del Senguerr anticline the San Bernardo Fold Belt largely consists of tablelands related to buried folds with limited surface expression (*e.g.*, the Los Perales and Cerro Ballena anticlines). Subsurface data from the Los Perales–Las Mesetas block indicate NNE– to NE–plunging folds with curved, offset axial traces that intersect minor NW-trending faults and fold systems (Vergés *et al.*, 1998). Changes in fold vergence among adjacent long-lived faults are associated with transtensional structures decoupled from the basement (Rojas Vera *et al.*, 2025). The later authors also produced an isochron map of the lower Bajo Barreal Formation, highlighting synsedimentary NW-striking normal faults that are highly oblique to "Neocomian" structures, pointing to non-coaxial extensional phases prior to inversion.

Recent studies have revitalized the Barcat *et al.* (1989) model, suggesting that fold development commenced in the late Early Cretaceous (Gianni *et al.*, 2015, 2018; Navarrete *et al.*, 2015). Although these works invoke contractional progressive unconformities and growth strata to support their kinematic interpretations, significant geometric inconsistencies cast doubt on their conclusions. This situation encompasses both subsurface and outcropping structures (Allard *et al.*, 2020, 2021). For instance, the Las Pulgas region exemplifies contrasting structural interpretations: Gianni *et al.* (2015) propose strong dip variations in the limb of the inversion fold, which are incompatible with in situ dip measurements (Fig. 4a, c). Another pivotal locality is the Sierra Silva anticline, where detailed geometric and kinematic analyses elucidate the timing of Cretaceous contraction. This anticline is interpreted as a N–S–trending, pop-up growth fold that exposes minor transverse faults and synextensional wedges of the lower Bajo Barreal Formation, restricting the onset of inversion to the Late Cretaceous (Allard *et al.*, 2020; Bueti *et al.*, in press; Fig. 4a). This timing is consistent with the extensional history of the Los Perales-Las Mesetas block (Rojas Vera *et al.*, 2025) and adjacent structural domains of the Cerro Dragón oilfield in the North Flank (Paredes *et al.*, 2013).

Furthermore, uppermost Upper Cretaceous strata provide considerable evidence of syncontractional sedimentation, including the Laguna Palacios Formation, which reflects low-accommodation conditions with isopach maxima along syncline axes (Sciutto, 1981) and progressive unconformities indicative of syn-sedimentary inversion folding (Allard *et al.*, 2021). In the southeastern SBFB, the La Chichita anticline displays syn-inversion uplift within the Lago Colhué Huapi Formation, recognized through growth strata, forelimb unconformities, and erosional truncation surfaces (Iglesias *et al.*, 2023). Subsequent Cenozoic contraction is further subdivided into Paleogene, Neogene, and Quaternary stages, with the younger pulses documented by tectonic geomorphologic features and evidence of neotectonic faulting (Allard *et al.*, 2021).

Western Flank

Studies on the tectonostratigraphic architecture of this region lag behind those of other onshore areas, largely due to the predominance of 2D seismic profiles, which have led to relatively immature structural models (Strelkov *et al.*, 1994). Moreover, recent contributions underscore significant geometric inconsistencies in interpretations of both outcropped and subsurface inversion structures (Allard *et al.*, 2021). Despite these challenges, this flank (or subbasin) exhibits a distinctive structural framework dominated by NNW to SSW normal faults, which form simple to complex half-grabens containing synrift "Neocomian" deposits up to several kilometers thick. By contrast, the Chubut Group and the Cenozoic successions are comparatively condensed.

Gravimetric data reveal a basement characterized by multiple intrabasinal paleohighs that compartmentalize or isolate individual depocenters (Miller and Marino, 2019). Although the master faults are widely recognized as extensional, their detailed kinematic history remains understudied, particularly with respect to fault geometries, emergent fault stages, the interactions of fault segments, and the associated footwall uplift processes. Nevertheless, existing structural maps do illustrate fault traces indicative of along-strike linkages—ranging from hard-link to soft-link transfer zones—although the local geometry remains underexplored.

Despite the proximity of this flank to the Andean margin, tectonic inversion is generally considered minimal or absent, yet the degree of inversion has not been quantified. Moreover, the coexistence of undisturbed half-grabens alongside folded synrift deposits linked to inverted faults suggests selective reactivation of principal structures. The synrift successions that fill these half-grabens also display localized secondary fault systems, which are only loosely or not at all coupled to the main fault or its associated hemi-horst. These secondary faults exhibit both positive and negative flower structures, suggesting the presence of a localized strike-slip component during oblique reverse reactivation.

Complex, multigenetic basement structures likely facilitated a hybrid inversion process, wherein fault reactivation is partially masked by subtle, cover-level folding. The large extensional displacements during earlier synrift phases, combined with the highly oblique structural trend during Andean compression, appear to be critical factors impeding a more widespread inversion phase. Presently, the inversion timing remains poorly constrained, owing in part to a lack of detailed geometric analyses capable of distinguishing contractional from extensional unconformities and growth strata. At a semi-regional scale, the top of the "Neocomian" units in the Los Sauces block lies above the regional datum defined within the SBFB. This pattern implies a semi-regional, clockwise rotation of multiple depocenters, punctuated by a series of pop-up growth folds in the SBFB region.

DISCUSSION

Unlocking new structural insights

Advancing in the structural characterization of the Golfo San Jorge Basin (GSJB) requires refined and updated geometric and kinematic models. Although the influence of basement fabrics on extensional fault arrays is often inferred from their shared fault orientations, robust seismic calibration is needed to distinguish exploitative, cross-cutting, and merging fault interactions. In particular, it is critical to assess the possible role of negative tectonic inversion in pre-rift contractional faults, which may account for the structural trend of the San Bernardo Fold Belt (Fig. 1a). Furthermore, current uncertainties in inverted areas underscore the need for additional multiscale structural studies that explore the differences between orthogonal and oblique inversion, selective inversion, fluid-pressure effects, along-strike variations in inversion degree, structural interference, strain partitioning, and diachronous uplift across and along the fold belt.

In contractional settings, extensional transfer zones can be inferred by abrupt changes in the strikes of inverted faults. Detailed analysis of inversion folds reveals curved axial traces and paired double-plunging structures, indicative of oblique or linear double linkages, respectively (Nabavi and Fossen, 2018; Fig. 4a). These patterns suggest along-strike linkage of segmented, major blind inverted faults. Moreover, fold interference with lower-order disharmonic folds at overlapping zones may represent the inversion of an extensional hard-linked synthetic transfer zone (Fig. 4b). In

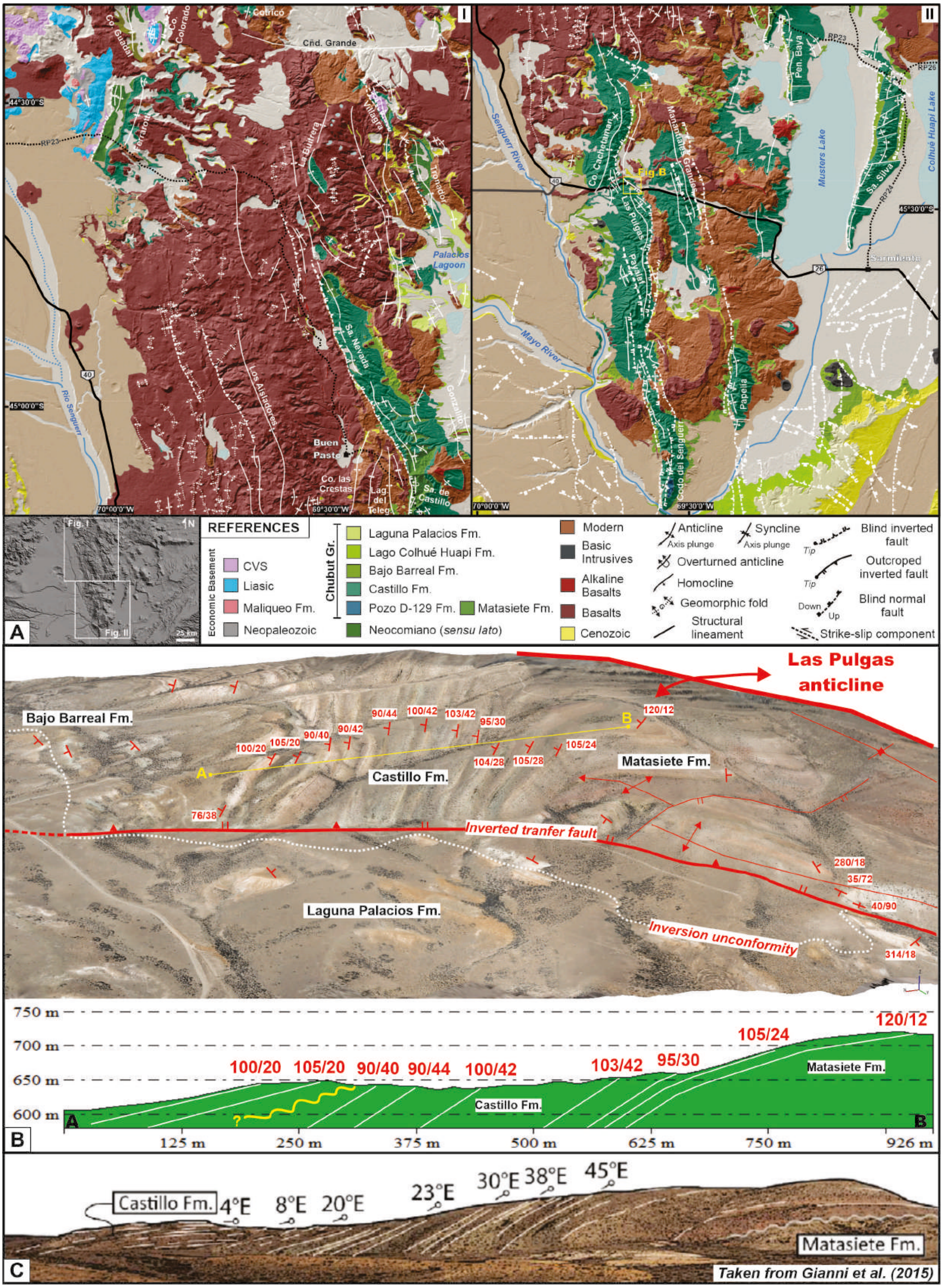

Figure 4. a) Geological map of the outcropped portion of the San Bernardo Fold Belt, modified from Allard *et al.* (2021). **b)** Digital outcrop model and simplified structural cross section of the Las Pulgas locality, based on in situ structural measurements. c) Proposed syn-inversion progressive unconformities (Gianni *et al.*, 2015). Note that these interpretations are incompatible with the observed data.

these areas, reverse faults are commonly associated with multiple null points, signaling variations in extensional throw that, in turn, govern inversion degree. Collectively, these along-strike changes point to localized increases in strain and contraction at inherited transfer zones.

In extensional settings, multiple non-coaxial extension phases trigger oblique basement fault reactivation, which can propagate into the sedimentary cover as flower-type fault systems. Such structures may evolve to include reverse faults, block rotations, or local tight folds. Further high-resolution geometric analyses are necessary to differentiate dip-slip transfer mechanisms from strike-slip components arising from strain partitioning. Conversely, coaxial phases promote dip linkage between basement-rooted and intraformational faults with vertical phase-out zones, resulting in planar flexure or flat-ramp geometries and fault-bend folds. Although unrecognized, this mechanism may explain the roll-over anticline traps described in the North and South flanks. In the Western Flank, thoroughly evaluating these inherited extensional architectures is crucial before attributing any anticlines to low-degree inversion processes.

Another significant topic requiring further investigation is paleostress and paleostrain reconstruction. While tectonic inversion is a key component of GSJB evolution, stress and depth inversion may occur independently of plate-motion dynamics, as surface processes, including sediment supply, can drive regional uplift (Mondy *et al.*, 2023). The effects of these processes on the Neocomian–Chubut Group unconformity in the Western Flank remain unexplored. Additionally, positive inversion likely diminishes overburden, elevating horizontal stress and potentially inducing strike-slip or thrust faulting, contingent on exhumation extent and fluid-pressure conditions (Peacock *et al.*, 2017). Testing these hypotheses demands fault-dating and thermochronological analyses to refine both timing and erosion estimates. Meanwhile, Plio-Pleistocene fluvioglacial plains in the eastern onshore domain exhibit several hundred meters of uplift with minimal contraction, further highlighting the need to reassess paleostress impacts during both subsidence and uplift phases.

Progress in these fields depends on the integration of subsurface and outcrop analyses, which also provide structural analogues that significantly enhance the calibration of petroleum systems. While geomechanical characterization and structural modeling are essential, these approaches should focus on the role of tuffaceous materials in multiscale deformation. Lithological factors may strongly influence microtectonic processes, structural diagenesis, fracture distributions, and fault architectures—considerations that have thus far been underexamined—. In addition, constructing synthetic seismic analogs from outcrop logs and panels could bridge varying scales and resolutions, allowing for rigorous evaluation of seismic architectures, sub-seismic fault systems, and underlying basement fabrics.

Tectonic evolution

The basement and prerift sequences of the Golfo San Jorge Basin (GSJB) reflect the prolonged tectonic evolution of an intraplate continental setting underlain by a Paleozoic trans-lithospheric suture, which was influenced by flat-slab development and thermal erosion driven by a mantle plume (Jalowitzki *et al.*, 2024). Building on this substrate, the basin's history was shaped by inherited mantle dynamics and the tectonic context defined by Gondwana fragmentation and concurrent Andean orogenesis, resulting in a polyphasic evolution wherein multiple tectonic regimes and paleostress reconstructions remain unresolved due to structural uncertainties. A weak thermomechanical lithosphere characterizes the Mesozoic mega-architecture, facilitating the nucleation of NW–SE–oriented basement faults and corresponding faults within the sedimentary cover (Fig. 1c). Spatio-temporal variations in Jurassic to "Neocomian" extensional depocenters, relative to the Middle to Late Cretaceous deposits of the Chubut Group—where maximum sedimentary thickness is observed near the basin center—demonstrate the interplay between tectonic and sag-related vertical movements. The calibration of this complex interaction requires filtering the isostatic uplift linked to the synrift phases (Kusznir *et al.*, 2002). Although Ramos (2021) proposed a scenario of unconfined compression during the Aptian–Albian, positioning the San Bernardo Fold Belt as a subtly uplifted wedge-top, available structural evidence indicates that the SBFB remained predominantly extensional until the Coniacian (Allard *et al.*, 2020; Bueti *et al.*, under review). Notably, in the latest Cretaceous, the onset of tectonic inversion in the Western Flank and the SBFB coincided with a sag phase in the Eastern Region, implying that inversion-related uplift is a multicausal process driven by the interplay among contraction-induced tectonic uplift, postrift thermal subsidence, and sediment redistribution (Oravecz *et al.*, 2024). Subsurface data south of the Codo del Senguerr anticline reveal localized uplift partly obscured by the broader thermal sag, suggesting that a shallow lithosphere–asthenosphere boundary under low convergence rates may foster the burial of inverted structures. Under these conditions, short-wavelength shortening at a semi-regional to local scale appears to govern the selective reverse reactivation of major faults. During the Cenozoic, multiphase shortening alternated with retroarc extension and passive-margin development (Folguera *et al.*, 2020; Bilmes *et al.*, 2021; Foix *et al.*, 2021), as subsidence mechanisms emerged from a complex interplay among tectonic stress, broken-foreland loading, and mantle processes (Gianni *et al.*, 2018). These processes lead to isostatic and dynamic compensation mechanisms, although the exact thermal effects remain uncertain. Within this multiproxy framework, the Neogene–Quaternary uplift of eastern onshore areas is primarily attributed to mantle dynamics rather than distal paleostress influences (Ávila and Dávila, 2020). Consequently, resolving the interplay between mantle dynamics and crustal deformation stands as a persistent challenge, requiring rigorous structural evidence to refine models, discard flawed interpretations, and establish more robust, synergistic tectonic frameworks.

CONCLUSIONS

The Golfo San Jorge Basin is a polyphase basin that experienced multiple tectonic regimes from the Middle Jurassic through the Neogene, offering a valuable natural laboratory for examining both extensional and inversion processes. At the basin scale, three-dimensional deformation predominates, reflected in the interplay between basement-involved faults and intraformational faults, which can be categorized as coaxial (favoring dip-slip linkage) or non-coaxial (decoupled). Notably, the positive tectonic inversion—manifested by significant vertical movements—is primarily confined to the San Bernardo Fold Belt and the Western Flank. A key structural issue in these areas is determining the precise timing of contractional deformation; current tectonostratigraphic data and structural evidence suggest that this initial contractional phase postdated deposition of the Bajo Barreal Formation, while the Lago Colhué Huapi–Laguna Palacios depositional system represents the Cretaceous syn-inversion interval. Further research into the kinematic evolution of these inverted structures, as well as the interplay between uplift-dominated and subsidence-dominated inversions, will enhance the understanding of basin architecture. Such refinements in structural analyses are essential for tectonic and geodynamic reconstructions of Patagonia and for accurate characterization of the basin's petroleum systems.

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