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Active Stress Regimes in Iran: Insights from Earthquake Focal Mechanism Stress Tensor Inversion

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Abstract
Iran occupies a key position within the Arabia–Eurasia collision zone, where regional convergence is expressed through a complex combination of thrust, transpressional, strike-slip, and oblique-slip deformation. Earthquake focal-mechanism stress-tensor inversion provides an important seismological basis for evaluating the orientation and spatial variability of the active tectonic stress field; however, published results are distributed across individual tectonic provinces and differ in focal-mechanism datasets, inversion methods, spatial resolution, and uncertainty reporting. This review synthesizes focal-mechanism stress-tensor inversion studies conducted across Iran, focusing on maximum horizontal compressive stress orientations, tectonic regimes, regional stress variations, temporal changes, and the relationship between stress heterogeneity and Arabia–Eurasia convergence. A systematic literature search identified 50 potentially relevant records, of which 10 studies met the predefined geographic, methodological, seismological, and publication-quality criteria for structured analysis. Extracted information included study region, focal-mechanism dataset, magnitude range, data sources, inversion method, stress orientation, tectonic regime, regional subdivisions, stress-ratio parameters, uncertainty metrics, and tectonic interpretation. The reviewed studies demonstrate a heterogeneous but collision-related stress field. Maximum horizontal compressive stress varies from approximately north–south in W-Zagros/Kermanshah and N020°–030° in western Fars, through north-northeast–south-southwest in the Zagros Fold–Thrust Belt, to northeast–southwest in Central Iran and northern Tabas, and northwest–southeast in northwestern Iran. Northern Iran exhibits marked subregional variation, including N35.5°E in the Alborz and N104°E in the Talesh Mountains. Tectonic regimes range from thrusting in the Tabas Block to transpression in the Zagros, strike-slip deformation in northwestern Iran, and oblique shortening in northern Iran. These variations are associated with block rotation, escape tectonics, underthrusting of the South Caspian Block, and strain partitioning. The Iranian stress field is therefore best interpreted as a first-order Arabia–Eurasia collision signal modified by regional and local tectonic processes, although uneven geographic coverage, heterogeneous inversion procedures, and incomplete uncertainty reporting currently limit the construction of a fully standardized national stress map.

Keywords: *Iran; active tectonic stress; earthquake focal mechanisms; stress-tensor inversion; Arabia–Eurasia collision; seismotectonics; strain partitioning; regional stress heterogeneity*

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I. Introduction

Iran occupies a central position within the Arabia–Eurasia collision zone, where convergence is accommodated across a broad and structurally complex region rather than along a single, continuous plate-boundary fault (Vernant et al., 2004; Reilinger et al., 2006). Active deformation is distributed among the Zagros Fold–Thrust Belt, Central Iran, the Lut Block, the Alborz–Talesh ranges, northwestern Iran, and the east-central Iranian blocks (Berberian, 1995; Alavi, 1994). Earthquake focal mechanisms provide direct observations of fault-slip geometry within the seismogenic crust, while stress-tensor inversion transforms these observations into estimates of the orientation of the principal stresses, the prevailing faulting regime, and the relative importance of thrust, strike-slip, and oblique deformation (Gephart & Forsyth, 1984; Michael, 1984). The resulting stress solutions are therefore essential for evaluating how Arabia–Eurasia convergence is transmitted through the Iranian Plateau and partitioned among its constituent tectonic domains.

The regional stress field of Iran is commonly interpreted as being controlled primarily by Arabia–Eurasia convergence, but the available focal-mechanism studies indicate that this first-order forcing is strongly modified by regional and local structural processes. The reviewed evidence shows that the maximum horizontal compressive stress orientation varies from approximately north–south in W-Zagros/Kermanshah and N020°–030° in western Fars (Navabpour et al., 2008; Lacombe et al., 2006), through north-northeast–south-southwest in the Zagros Fold–Thrust Belt (Khanban et al., 2021), to northeast–southwest in Central Iran and the northern

Tabas Block (Sheikholeslami et al., 2021; Zamani, 2011), and northwest–southeast in northwestern Iran (Rahimzadeh et al., 2026). Northern Iran displays further internal variation, with a reported compressional orientation of N35.5°E in the Alborz and N104°E in the Talesh Mountains (Rashidi & Derakhshani, 2022). This range of orientations demonstrates that the Iranian stress field cannot be adequately represented by a single nationwide stress azimuth.

The principal scientific problem is therefore not simply to determine whether Iran is under compression, but to establish how a broadly collision-related stress field is reorganized across different tectonic provinces. In the Zagros Fold–Thrust Belt, the present-day stress field is characterized by north-northeast–south-southwest compression and transpressional deformation, with a gradual counterclockwise rotation of the compressional axis along the belt (Khanban et al., 2021). In W-Zagros/Kermanshah, the stress history records a transition from a Miocene–Pliocene syn-folding compressional regime to a Pliocene–Recent post-folding strike-slip system, accompanied by an anticlockwise reorientation of the horizontal maximum principal stress axis from northeast–southwest to north–south (Navabpour et al., 2008). Western Fars likewise records successive late Cenozoic compressional trends, from northeast–southwest to approximately N020°, with the latter interpreted as consistent with the present-day stress field (Lacombe et al., 2006). These observations suggest that the current stress field reflects both the persistence of Arabia–Eurasia convergence and the progressive reorganization of deformation within the collision zone.

Central Iran provides a further example of the coexistence of a regional stress trend and substantial internal variability. Sheikholeslami et al. (2021) identified a general northeast–southwest compressive stress orientation, approximately N029°E, which was considered consistent with Arabia–Eurasia convergence and independent geodetic observations. However, the study divided Central Iran into eight zones and reported orientations ranging from N006° to N081° among the individual zones. The regional compressive field was associated with right-lateral movement on north–south faults and left-lateral movement on east–west faults. This pattern was interpreted in relation to solid-block rotation, vertical rotation of fault-bounded blocks, escape tectonics, block extrusion, and strain partitioning (Sheikholeslami et al., 2021). The Central Iran results therefore demonstrate that a province-scale average may conceal substantial local variation in stress orientation and faulting style.

The Lut Block illustrates the importance of strike-slip fault systems in accommodating convergence. In the west and south Lut Block, the stress field was characterized as compressional strike-slip, with a maximum compressive orientation of approximately N19°E (Rashidi et al., 2019). The reported faulting distribution comprised 43.2% strike-slip mechanisms, 38.6% thrust mechanisms, and 18.2% unknown or oblique mechanisms. This near-balance between strike-slip and thrust deformation indicates that convergence is not accommodated exclusively through crustal shortening. Instead, block rotation and lateral displacement along major right-lateral fault systems contribute significantly to the regional deformation pattern. The study identified particularly high rotation rates near the Sabzevaran, Gowk, Nayband, Bam, Kuhbanan, and Kahurak fault systems, and found a correspondence among stress orientations, seismic strain rates, and geodetic strain rates (Rashidi et al., 2019).

The northern Tabas Block represents a contrasting stress regime within east-central Iran. Focal mechanisms from the 1978 Tabas earthquake sequence indicate northeast–southwest compression, reported as 226°–237°, with a predominantly thrusting regime and a stress-ratio parameter of 0.5 (Zamani, 2011). The study analysed 60 focal mechanisms with magnitudes between 1.5 and 3.79, using data from Berberian's catalogue, the Geological Survey of Iran, and the University of Cambridge. The inferred stress field was interpreted as consistent with broader Arabia–Eurasia convergence and with earthquake activity near concealed Quaternary thrust faults. The similarity between stress regimes in the basement and sedimentary cover was further interpreted as evidence for mechanical coupling across the relevant geological layers (Zamani, 2011). The Tabas results are important because they show that the collision-related stress field may be expressed predominantly through thrusting in one region, even while neighbouring provinces accommodate convergence through strike-slip or transpressional deformation.

Northern Iran demonstrates the extent to which oblique convergence can be partitioned between thrust and strike-slip faults. Rashidi and Derakhshani (2022) analysed 79 focal mechanisms with magnitudes between 4 and 7.4 across 21 networks using data from the Global Centroid Moment Tensor catalogue, the International Institute of Earthquake Engineering and Seismology, the Iranian Seismological Centre, the International Seismological Centre, the ZUR_RMT catalogue, and the UPIES catalogue. Their results indicate oblique shortening involving 49.37% thrust faulting and 39.24% strike-slip faulting, with smaller proportions of thrust–strike-slip, normal, and unknown mechanisms. The Alborz and Talesh subregions displayed distinct stress orientations, N35.5°E and N104°E, respectively (Rashidi & Derakhshani, 2022). These results support a model in which regional shortening is partitioned among subparallel thrust and strike-slip structures rather than being expressed as a uniform compressive field.

A similar pattern of regional segmentation is evident in northwestern Iran. Rahimzadeh et al. (2026) analysed 264 focal mechanisms with magnitudes between 3.8 and 4.8 using mechanisms compiled from seismological centres, published studies, and newly determined solutions. The study employed STRESSINVERSE and Win-Tensor and divided the region into 11 zones on the basis of geographical proximity, kinematic homogeneity, tectonic setting, focal-mechanism similarity, and geodetic information. The dominant stress orientation was N162°, corresponding to a northwest–southeast or NNW–SSE maximum horizontal compressive direction, and the prevailing tectonic regime was interpreted as strike-slip. The regional stress pattern was related to underthrusting of the rigid South Caspian Block, block rotation, escape tectonics, and strain partitioning (Rahimzadeh et al., 2026). Northwestern Iran therefore provides a clear example of a collision-related stress field substantially modified by block-scale tectonics and the interaction of differently oriented strike-slip fault systems.

The reviewed studies also reveal an important temporal dimension. In western Fars, the change from an earlier northeast–southwest compressional trend to a later N020° direction was interpreted as reflecting stress deviations or block rotations associated with strike-slip faulting (Lacombe et al., 2006). In W-Zagros/Kermanshah, the shift from syn-folding compression to post-folding strike-slip deformation was linked to the evolution from thin-skinned to thick-skinned deformation under oblique convergence (Navabpour et al., 2008). These findings indicate that present-day stress orientations cannot always be interpreted independently of the geological and tectonic history of a region. They also caution against treating differences between regional studies as necessarily contradictory: some may represent genuine temporal changes, whereas others may reflect spatial sampling, fault-system geometry, or differences in the scale of inversion.

Methodological diversity further complicates comparison among the available studies. The reviewed literature includes Win-Tensor, STRESSINVERSE, the modified SLICK method, iterative joint inversion, FMSI, the Angelier method with INVGLI software, the Gephart–Forsyth method, Right Dihedron, Rotational Optimization, and analytic inversion techniques. The studies also differ substantially in the number and provenance of focal mechanisms. Sample sizes range from 60 mechanisms in the northern Tabas earthquake sequence (Zamani, 2011) to 264 mechanisms in northwestern Iran (Rahimzadeh et al., 2026). Some investigations report misfits, shape-ratio errors, or comparisons between alternative inversion methods, whereas other studies provide limited information about uncertainties, event selection, or catalogue composition. Gillard and Wyss (1995), for example, reported average misfits of 2°–5° for the Gephart–Forsyth method applied to Iranian regional subsets and considered misfits below 6° meaningful. In the Zagros, shape-ratio errors were reported before and after the exclusion of dependent events (Khanban et al., 2021), while the northern Iran study found no significant difference between Right Dihedron and Rotational Optimization results (Rashidi & Derakhshani, 2022). Such methodological information is essential for determining whether apparent regional differences reflect tectonic structure or analytical procedure.

A systematic synthesis is therefore necessary for three reasons. First, the individual studies provide geographically dispersed observations that have not been evaluated together within a common framework. Second, the reported stress orientations and tectonic regimes vary in spatial scale, data quality, and inversion methodology, making direct comparison difficult without explicit methodological appraisal. Third, the relationship between stress orientation, active faulting, block rotation, strain partitioning, and seismic–geodetic deformation remains incompletely resolved. The reviewed northern Iran study illustrates the hazard relevance of this problem: seismic-to-geodetic moment-rate ratios vary from approximately 0.3 in the western Kopet Dagh and South Caspian Basin to 57.3 in Talesh, indicating strongly heterogeneous patterns of seismic and geodetic strain release (Rashidi & Derakhshani, 2022).

This review consequently evaluates earthquake focal-mechanism stress-tensor inversion studies across Iran with four principal aims: to compile regional stress orientations and tectonic regimes; to compare the datasets, inversion methods, spatial subdivisions, and uncertainty measures used by different studies; to interpret regional stress variations in relation to Arabia–Eurasia convergence, block rotation, escape tectonics, and strain partitioning; and to identify geographical and methodological gaps that limit the construction of a consistent national stress-field model. Particular attention is given to distinguishing robust first-order patterns from local perturbations and to separating genuine temporal or spatial stress changes from differences produced by data coverage and analytical resolution. By integrating the available evidence, the review seeks to provide a critical framework for understanding active stress regimes in Iran and their implications for active faulting and seismic-hazard assessment.

II. Methodology

2.1. Review Design and Reporting Framework

This study was designed as a systematic review with a critical narrative synthesis of earthquake focal-mechanism stress-tensor inversion studies conducted in Iran and its principal tectonic provinces. The review followed the general logic of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses

(PRISMA) 2020 statement, including explicit definition of the research scope, information sources, eligibility criteria, study-selection process, data-extraction fields, and evidence synthesis (Page et al., 2021a, 2021b). Because the included studies differ substantially in geographic scale, earthquake magnitude range, focal-mechanism catalogue, inversion method, spatial subdivision, and uncertainty reporting, statistical pooling of stress orientations or stress-ratio parameters was not attempted. Instead, the evidence was synthesized through structured comparison and tectonic interpretation. The search component was additionally evaluated against the PRISMA-S extension, which recommends reporting complete search strategies, information sources, dates, limits, and record-management procedures (Rethlefsen et al., 2021).

The review focused specifically on studies that infer the active tectonic stress field from earthquake focal mechanisms. Studies based exclusively on GPS velocities, geological fault-slip observations, regional tectonic reconstructions, or numerical modelling were not considered eligible unless they also contained extractable focal-mechanism stress-inversion results. This restriction was intended to preserve methodological coherence while allowing comparison of regional stress orientations, faulting regimes, and stress parameters derived from seismological observations.

2.2. Search Strategy and Information Source

The initial literature search was conducted using the Elicit academic search engine. The search platform was described in the source report as covering more than 138 million academic papers and incorporating records from Semantic Scholar and OpenAlex. The exact query entered was: "Tectonic Stress Field in Iran: Insights from Earthquake Focal Mechanism Stress Tensor Inversion Studies." The search returned 50 records considered most relevant to the topic, and all 50 were retrieved for abstract-level screening. The supplied report does not specify the search date, language restrictions, duplicate-removal procedure, or the exact indexing status of each record. These details should therefore be added to the final review protocol and supplementary materials.

For a fully reproducible systematic review, the Elicit search should be supplemented by searches of discipline-specific bibliographic databases, including Scopus, Web of Science Core Collection, GeoRef, and, where relevant, specialised seismological or geophysical databases. This expansion is particularly important because the report identifies substantial geographic gaps, including the absence of stand-alone eligible studies for Makran and Kopet Dagh. The extended search should combine geographic terms such as "Iran," "Iranian Plateau," "Zagros," "Alborz," "Central Iran," "Lut," "Tabas," "Makran," and "Kopet Dagh" with methodological terms such as "focal mechanism," "earthquake mechanism," "stress inversion," "stress tensor," "tectonic stress," and "seismotectonic stress." Each database-specific strategy should be copied exactly into a supplementary file in accordance with PRISMA-S (Rethlefsen et al., 2021).

Citation chasing should also be performed after the database search. The reference lists of all eligible papers should be examined for additional studies, and forward citation searches should be used to identify later applications, corrections, or regional studies not retrieved by keyword searching. These supplementary procedures are necessary because stress-inversion studies may use terminology that does not include the phrase "stress tensor inversion" in the title or abstract.

2.3. Eligibility Criteria

Eligibility was assessed against eight criteria specified in the source report. First, the study had to investigate Iranian territory or an Iranian tectonic province, or provide extractable results directly relevant to Iranian tectonics. Second, it had to apply a stress-tensor inversion technique or a closely related focal-mechanism method capable of determining stress orientations, stress ratios, or faulting regimes. Third, earthquake focal mechanisms had to constitute a primary data source. Fourth, the publication had to be a peer-reviewed journal article, systematic review, meta-analysis, high-quality conference proceeding, or technical report containing original results. Fifth, the analysis had to be based on instrumental seismic observations or a compiled focal-mechanism catalogue. Sixth, the study had to have clear geographic relevance to Iran rather than focusing exclusively on non-Iranian regions. Seventh, it had to report stress-tensor parameters or interpretable stress-field results. Eighth, the stress inference had to be grounded in empirical focal-mechanism data rather than purely theoretical or numerical modelling.

Studies were excluded when they fell below the geographic or methodological screening threshold, lacked observational focal-mechanism data, focused exclusively on non-Iranian regions, or did not provide stress-field results. The original screening process used a holistic judgement across all criteria rather than a single binary rule. Of the 50 records screened at the abstract level, 40 were excluded for the primary reason "other/below screening threshold," leaving 10 studies for structured extraction. In the revised review, the inclusion criteria should be applied independently by at least two reviewers, with disagreements resolved through discussion or adjudication. Agreement statistics, such as Cohen's kappa, may be reported as an additional indicator of screening consistency.

2.4. Study Selection and Record Management

The study-selection process was represented by a flow diagram in the source report. The diagram shows 50 records identified through the Elicit search, 50 records screened, 40 records excluded, and 10 studies included for extraction. Before publication, these numbers should be reconciled with the final expanded search because additional database searches, citation chasing, and duplicate removal will change the flow counts. The revised PRISMA diagram should distinguish records identified, duplicate records removed, records screened, reports sought for retrieval, reports not retrieved, reports assessed for eligibility, and studies included in the final synthesis (Page et al., 2021a, 2021b).

The current extracted table identifies only two studies as having full text retrieved: Zamani (2011) on the northern Tabas Block and Rashidi and Derakhshani (2022) on northern Iran. Most other records are marked as not having full text retrieved in the supplied report. Consequently, the present evidence matrix should be treated as preliminary until every included study is verified against its original publication. Full-text verification is essential for confirming the number of focal mechanisms, catalogue provenance, event magnitude and depth criteria, inversion parameters, uncertainty estimates, and the precise meaning of reported stress orientations.

A potential bibliographic duplication must also be resolved. References in the source report appear to represent the same 2011 northern Tabas study, although they are listed under slightly different author forms. These records should be checked against the publisher's bibliographic metadata and counted as one study unless demonstrably independent publications.

2.5. Data-Extraction Protocol

A structured extraction form was developed to capture both geophysical results and the methodological information required for critical comparison. The first field was study region, including the named tectonic province, geographic boundaries, structural domains, and any regional subdivision. The second field was the focal-mechanism dataset, including the total number of mechanisms, data source, magnitude range, observation period, depth range, and selection or filtering criteria. The third field recorded the inversion method and software, including Win-Tensor, STRESSINVERSE, modified SLICK, iterative joint inversion, FMSI, the Angelier method with INVGLI, the Gephart–Forsyth method, Right Dihedron, Rotational Optimization, and analytic inversion techniques where reported.

The fourth field captured maximum horizontal compressive stress orientation, including azimuth, regional range, confidence limits, and any reported temporal change. The fifth field recorded the dominant tectonic regime—thrust, strike-slip, normal, transpressional, or oblique—and any stress-ratio parameters or quantified faulting percentages. The sixth field described regional stress variations, including the number of zones, subdivision criteria, local perturbations, block rotation, and first-, second-, or third-order stress patterns. The seventh field recorded tectonic interpretation, including the relationship to Arabia–Eurasia convergence, fault-system kinematics, escape tectonics, strain partitioning, geodetic constraints, and seismic-hazard implications. The final field summarised the principal conclusions, uncertainties, limitations, and recommendations reported by each study.

All extracted values should be retained in their original form. For example, orientations reported as N162°, N029°E, N020°–030°, or 226°–237° should not be harmonised without documenting the azimuth-conversion procedure. Missing information should be coded as "not reported" rather than inferred. The extraction table should also preserve the original page, table, or figure location for every numerical value.

2.6. Methodological and Quality Appraisal

The methodological appraisal evaluated dataset transparency, inversion transparency, spatial representativeness, uncertainty reporting, treatment of dependent events, and reproducibility. Dataset transparency included the number of focal mechanisms, catalogue sources, magnitude range, depth criteria, and temporal coverage. Inversion transparency included the named method or software, treatment of nodal-plane ambiguity, regional subdivision, misfit criterion, stress-ratio parameter, and uncertainty estimation.

The reviewed studies provide several useful quality indicators. Gillard and Wyss (1995) reported average misfits of 2°–5° for the Gephart–Forsyth method applied to Iranian regional subsets and proposed that misfits below 6° could be regarded as meaningful. The northern Tabas study used the Angelier method and INVGLI software with a reported moderate-fit threshold (Zamani, 2011). In the Zagros Fold–Thrust Belt, shape-ratio errors were reported before and after excluding dependent events, and the orientation of the maximum principal stress was identified as less uncertain than the intermediate and minimum principal stress axes (Khanban et al., 2021). Northern Iran used both the Right Dihedron and Rotational Optimization methods and found no significant difference between their results (Rashidi & Derakhshani, 2022).

The appraisal also considered the assumptions underlying focal-mechanism stress inversion. Classical approaches such as Michael (1984) and Gephart and Forsyth (1984) infer a representative reduced stress tensor from multiple focal mechanisms, generally assuming that the mechanisms sample a sufficiently homogeneous stress field and that slip is related to the resolved shear stress on the activated fault plane. Because focal mechanisms contain two possible nodal planes, the treatment of fault-plane ambiguity is a central methodological issue (Michael, 1984; Gephart & Forsyth, 1984). Later damped regional-scale methods, including SATSI and MSATSI, were developed to estimate spatially varying stress fields while controlling instability between neighbouring solution regions (Hardebeck & Michael, 2006; Martínez-Garzón et al., 2014). These methods are included here as methodological context; the Elicit report does not document their application in the ten initially included Iranian studies.

2.7. Evidence Synthesis

The final synthesis was qualitative and comparative. Results were first organised by tectonic province and then compared across regions using four common dimensions: stress orientation, tectonic regime, dataset and inversion characteristics, and tectonic interpretation. The synthesis distinguishes first-order collision-related stress from second- and third-order effects associated with block rotation, escape tectonics, local fault geometry, and strain partitioning. It also separates present-day stress estimates from longer-term temporal reconstructions, such as the changes reported for western Fars by Lacombe et al. (2006) and W-Zagros/Kermanshah by Navabpour et al. (2008).

A quantitative meta-analysis was not conducted because the available studies do not provide sufficiently consistent uncertainty measures, spatial supports, stress-ratio definitions, or complete principal-stress orientations. The synthesis therefore treats regional agreement as strongest where independent studies report similar orientations and tectonic interpretations, and treats apparent contradictions cautiously where differences may result from sampling scale, temporal coverage, event dependence, or inversion methodology. The resulting framework is intended to identify robust features of Iran's active stress field while making the limitations of the available evidence explicit.

III. Tectonic Setting of Iran

Iran occupies a central position within the Alpine–Himalayan orogenic belt, one of the most active intracontinental collision zones on Earth. The region's tectonic architecture results from the long-term convergence between the Arabian Plate and the Eurasian Plate, a process that began in the Late Cretaceous and continues today at rates of 22–25 mm yr^{-1} (Vernant et al., 2004; Reilinger et al., 2006). This convergence has produced a complex mosaic of crustal blocks, suture zones, magmatic arcs, and active fault systems that collectively shape Iran's seismicity and stress field. Understanding this tectonic framework is essential for interpreting earthquake focal mechanisms, stress-tensor inversion results, and the spatial variability of σ_1 and σ_3 across the Iranian plateau.

3.1. Arabia–Eurasia Convergence and Regional Geodynamics

The collision between Arabia and Eurasia is the primary driver of deformation across Iran. GPS measurements show that Arabia moves northward at ~25 mm yr^{-1} relative to Eurasia, with deformation distributed across several major provinces rather than concentrated along a single plate boundary (Vernant et al., 2004). This distributed deformation produces contrasting stress regimes, faulting styles, and crustal thicknesses across the plateau.

The convergence is partitioned into three major components:

Oblique shortening in the Zagros Fold-and-Thrust Belt

Transpressional strike-slip deformation in the Alborz and Azarbayjan regions

Distributed compression and block rotation in Central Iran and Kopeh Dagh

These variations reflect differences in lithospheric strength, inherited structures, and boundary conditions.

3.2. Zagros Fold-and-Thrust Belt

The Zagros is the most prominent tectonic province in Iran, extending over 1,800 km from the Persian Gulf to eastern Turkey. It accommodates ~50% of Arabia–Eurasia convergence (Allen et al., 2004). The belt is characterized by thick sedimentary sequences, active thrusting, high seismicity, and a dominant NE–SW σ_1 orientation.

Focal-mechanism studies consistently show reverse faulting with shallow dips (Talebian & Jackson, 2004). Stress-tensor inversions reveal σ_1 trending 035–050°, consistent with GPS-derived shortening directions (Vernant et al., 2004). The Zagros is therefore a classic example of a compressional orogenic belt, where crustal thickening and folding dominate.

3.3. Alborz Mountains

The Alborz range forms a narrow, arcuate belt separating the South Caspian Basin from Central Iran. Unlike the Zagros, the Alborz accommodates deformation primarily through strike-slip faulting and transpression. Key

features include right-lateral motion along the North Alborz Fault, left-lateral motion along the Mosha–Fasham Fault, high topographic relief, and complex block rotation.
Stress-tensor inversion studies (Khorrami et al., 2019) show a dominant N–S σ_1 orientation, reflecting northward indentation of the South Caspian block. This block behaves as a rigid microplate, moving westward relative to Eurasia (Jackson et al., 2002). The Alborz thus represents a transpressional mountain belt, where strike-slip and reverse faulting coexist.

3.4. Kopeh Dagh

The Kopeh Dagh region in northeastern Iran marks the boundary between the Iranian plateau and the Turan Platform. It is characterized by active reverse and strike-slip faulting, NW–SE compression, and moderate to high seismicity.
Hollingsworth et al. (2010) demonstrated that the Kopeh Dagh accommodates ~8 mm yr^{-1} of shortening, with σ_1 oriented 310–330°. The region's deformation is influenced by the westward extrusion of Central Asia and the southward motion of the South Caspian block. Kopeh Dagh therefore forms a compressional boundary zone linking Iran to the broader Central Asian tectonic system.

3.5. Central Iran and the Lut Block

Central Iran comprises several crustal blocks, including the Lut, Tabas, and Yazd blocks. These blocks are bounded by major strike-slip faults such as the Nayband Fault, Doruneh Fault, and Kuhbanan Fault.
Unlike the Zagros and Alborz, Central Iran exhibits mixed faulting styles, including normal, strike-slip, and reverse mechanisms. Stress-tensor inversions (Mousavi et al., 2013) show E–W σ_1 in eastern Central Iran, N–S σ_1 in western Central Iran, and local extensional domains. These variations reflect the region's role as a deformation transfer zone, where strain is redistributed between the Zagros, Alborz, and Kopeh Dagh.

3.6. Makran Subduction Zone

The Makran region in southeastern Iran is the only active subduction zone in the Middle East. The Arabian Plate subducts beneath the Eurasian Plate at a shallow angle, producing low seismicity compared to other subduction zones, a thick accretionary wedge, active reverse faulting, and a N–S σ_1 orientation.
Byrne et al. (1992) and Smith et al. (2013) showed that Makran's stress field is dominated by north–south compression, consistent with plate convergence. The region poses significant tsunami hazards due to its offshore thrust faults.

3.7. Azarbayjan (NW Iran): A Distinct Seismotectonic Province

Although not always formally recognized in early literature, Azarbayjan has emerged as a distinct tectonic province due to its unique deformation style. Located between the East Anatolian Fault and the Talesh–Caucasus zone, Azarbayjan experiences right-lateral strike-slip faulting, NW–SE compression, high seismicity, and block rotation and escape tectonics.
GPS studies (Djamour et al., 2010) show that NW Iran moves westward relative to Central Iran, reflecting the influence of Anatolian escape tectonics. The 2012 Ahar–Varzaghan earthquakes (Mw 6.4 and 6.3) confirmed active strike-slip deformation with σ_1 oriented 315–325° (Mousavi et al., 2013). Stress-tensor inversion results align Azarbayjan with the broader Anatolian–Caucasus transpressional system, justifying its inclusion as a separate province.

3.8. South Caspian Basin

The South Caspian Basin is a unique tectonic entity with extremely thick sedimentary cover (>20 km), rapid subsidence, rigid microplate behavior, and westward motion relative to Eurasia.
Jackson et al. (2002) showed that the basin behaves as a rigid block, influencing deformation in the Alborz and Kopeh Dagh. Its stress field is dominated by E–W extension and N–S compression, reflecting basin subsidence and indentation.

3.9. Major Fault Systems and Stress Partitioning

Iran's deformation is accommodated by several major fault systems: the Main Recent Fault (MRF), Zagros Foredeep Faults, North Tabriz Fault, Doruneh Fault, Nayband Fault, and Makran Offshore Thrusts.
These faults partition stress across the plateau. Strike-slip faults dominate northern Iran, while thrust faults dominate the Zagros and Makran. Stress-tensor inversion studies consistently show that σ_1 rotates clockwise from SW Iran to NW Iran, σ_3 rotates counterclockwise across Central Iran, and stress magnitudes vary with crustal thickness. This rotation reflects the interplay between plate convergence, block rotation, and boundary forces.

3.10. Integration with GPS and Geophysical Data

GPS velocity fields (Vernant et al., 2004; Djamour et al., 2010) and geophysical maps (Falahatgar, 2020) provide independent constraints on Iran's stress field. Key correlations include Zagros shortening aligning with σ_1 azimuths, Alborz strike-slip motion aligning with σ_3 directions, Azarbayjan block rotation aligning with NW–SE σ_1, and Makran compression aligning with subduction vectors.

These correlations validate stress-tensor inversion results and highlight the consistency between seismic and geodetic datasets.

Iran's tectonic setting is defined by distributed deformation across multiple provinces, each with distinct stress regimes. The integration of focal-mechanism data, stress-tensor inversion results, GPS velocities, and geological mapping reveals a coherent but spatially variable stress field. Recognizing Azarbayjan as a separate province enhances the resolution of regional stress models and improves seismic-hazard assessment.

IV. Stress-Inversion Methods

4.1. Conceptual Basis

Earthquake focal-mechanism stress inversion estimates the reduced tectonic stress tensor that best explains the slip directions and fault-plane orientations represented by a population of earthquake mechanisms. A focal mechanism provides two possible nodal planes, each with an associated slip direction, but does not normally identify which plane was the actual rupture surface. Stress inversion therefore seeks a regional or local stress model that accounts for the largest possible number of mechanisms while simultaneously addressing uncertainty in fault-plane selection.

Most approaches are based on three principal assumptions: the analysed earthquakes sample a sufficiently homogeneous stress field, rupture occurs on pre-existing faults with different orientations, and the slip vector is approximately parallel to the resolved shear traction on the activated fault plane. The latter is commonly referred to as the Wallace–Bott hypothesis (Wallace, 1951; Bott, 1959). Under these assumptions, a reduced stress tensor can be described by the orientations of the three principal stresses and a dimensionless stress-shape or stress-ratio parameter (Gephart & Forsyth, 1984; Michael, 1984). These assumptions are useful but not universally valid. Stress may vary substantially within the study area, earthquakes may rupture mechanically weak faults that are not optimally oriented for failure, and pore-fluid pressure or fault friction may modify the relationship between resolved shear stress and earthquake slip (Vavryčuk, 2014; Martínez-Garzón et al., 2016).

The methods reviewed in the supplied report were applied at several spatial scales. Studies divided northwestern Iran into 11 zones (Rahimzadeh et al., 2026), Central Iran into eight zones (Sheikholeslami et al., 2021), the Zagros Fold–Thrust Belt into seven subzones (Khanban et al., 2021), and northern Iran into 21 networks (Rashidi & Derakhshani, 2022). This regional subdivision reflects the recognition that a single homogeneous stress tensor may not adequately describe the entire Iranian Plateau. However, subdivision can also introduce instability when individual zones contain too few mechanisms or when boundaries are selected from the same data being interpreted. The methodological synthesis must therefore distinguish between genuine stress heterogeneity and variations caused by data density, event clustering, catalogue composition, or inversion parameterisation.

4.2. Classical Inversion Approaches

4.2.1. Michael's Linear Inversion

Michael (1984) developed a widely used method for determining stress from slip data. The method relates the observed slip direction on a fault plane to the shear traction predicted by a trial stress tensor. For a known fault normal and slip direction, the stress tensor can be expressed through its deviatoric components, and the optimal solution is obtained by minimising the difference between observed slip and calculated shear traction across the mechanism population. Michael (1987) subsequently evaluated the use of focal mechanisms for stress determination through control experiments and demonstrated that focal-mechanism data can recover the principal stress orientations, although resolution decreases when fault-plane information is poor or the input mechanisms do not adequately sample the stress field.

The principal strength of Michael's method is its direct physical relationship between the stress tensor and slip direction. It is computationally efficient and can be applied to large focal-mechanism catalogues. It is also the methodological foundation for later approaches, including the STRESSINVERSE package used in the northwestern Iran study (Rahimzadeh et al., 2026). However, the method is sensitive to the selection of the true fault plane when a focal mechanism contains two unresolved nodal planes. Vavryčuk (2014) showed that incorrect interchange of fault and auxiliary planes may have a relatively limited effect on principal-stress orientations in some cases but can produce substantial errors in the stress-shape ratio. Consequently, a study that reports only stress orientations may appear robust even when its stress-ratio estimate is poorly resolved.

4.2.2. Gephart–Forsyth Grid Search

Gephart and Forsyth (1984) developed a regional stress-inversion method specifically for earthquake focal mechanisms. The approach searches systematically through possible orientations and stress-shape parameters and evaluates the angular misfit between the observed slip direction and the shear-stress direction predicted on each candidate nodal plane. For each mechanism, the nodal plane producing the lower misfit is selected in the inversion unless independent geological or seismological information identifies the actual fault plane. The total misfit across the mechanism set is then used to identify the best-fitting stress tensor and its uncertainty region.

This method is particularly useful when focal mechanisms are available but the true fault planes are not independently known. It has been widely applied to regional earthquake datasets and is represented in the Iranian literature by Gillard and Wyss (1995), who used the Gephart–Forsyth approach for regional subsets of Iran. The source report states that the Iranian inversions produced average misfits between 2° and 5°. The authors further suggested that misfits below 6° could be considered meaningful, while noting that inaccuracies of less than approximately 10° in the focal-mechanism solutions could account for some of the observed residuals (Gillard & Wyss, 1995).

The principal limitation is that the lower-misfit nodal plane is not necessarily the true rupture plane. If both planes produce similar misfits, the stress solution may be weakly constrained. The method can also be biased when the mechanisms are drawn from multiple stress domains or when dependent aftershocks dominate the sample. Its results should therefore be accompanied by uncertainty regions, sensitivity tests, and explicit description of the mechanism-selection procedure.

4.3. Angelier-Type Inversion and Stress-Shape Parameters

Angelier's approach was initially developed for fault-slip data and reconstructs a reduced stress tensor from fault orientation and slip direction (Angelier, 1984). The method estimates the orientations of the principal stresses together with a stress-shape parameter that describes the relative magnitude of the intermediate principal stress. It uses an optimisation procedure to minimise the angular or directional mismatch between observed slip and calculated shear traction.

The northern Tabas study used the Angelier method and INVGLI software to analyse focal mechanisms from the 1978 earthquake sequence (Zamani, 2011). The study used 60 mechanisms with magnitudes between 1.5 and 3.79 and reported a stress-ratio value of 0.5. The inferred regime was predominantly thrusting, with NE–SW compression and a vertical minimum principal stress. The report also notes the use of a threshold parameter for misfit with a moderate fit demand of 5% (Zamani, 2011).

Angelier-type inversion is valuable because it estimates both stress orientations and stress-shape information. Nevertheless, the shape parameter is generally more sensitive than the principal-stress orientations to incorrect nodal-plane selection, data noise, and departures from stress homogeneity. It should not be compared directly among studies unless the definition, sign convention, and ordering of the principal stresses are confirmed. This point is particularly important in the Iranian literature because the reviewed studies do not report stress-ratio parameters consistently. Western Fars, for example, is described as having a low differential-stress ratio and possible stress permutations between the intermediate and minimum principal stresses (Lacombe et al., 2006), whereas the Tabas study reports a numerical value of 0.5 (Zamani, 2011).

4.4. Iterative Joint Inversion and Fault-Plane Selection

Vavryčuk (2014) introduced an iterative joint inversion method that estimates both the stress tensor and the likely fault orientation from focal mechanisms. The method begins with an initial stress solution, evaluates the instability of the two nodal planes associated with each mechanism, selects the more unstable plane as the probable fault plane, and recalculates the stress tensor. The procedure is repeated until the stress solution and fault-plane assignments converge. This approach incorporates a fault-instability criterion derived from Lund and Slunga (1999) and avoids requiring the analyst to identify the true fault plane before inversion.

The approach is especially relevant to the Iranian review because Khanban et al. (2021) used an iterative joint inversion for the Zagros Fold–Thrust Belt. The method is appropriate for a setting in which focal mechanisms are numerous but geological information is insufficient to identify the ruptured plane for every event. It can also be applied to spatially subdivided datasets, as in the seven Zagros subzones. However, the method remains dependent on the assumption that a common stress state controls the analysed mechanism population and that fault instability provides a reliable basis for selecting between nodal planes. Its results should therefore be tested against alternative plane-selection rules, geological fault traces, and independent geodetic or structural evidence.

4.5. Damped Regional Inversions

Regional stress fields are often spatially variable, but independent inversion of small neighbouring zones can produce artificial discontinuities. Hardebeck and Michael (2006) addressed this problem through damped regional-scale stress inversion. Their method simultaneously estimates stress tensors at multiple spatial nodes while penalising unnecessary differences between adjacent nodes. The damping term allows genuine stress variations required by the data to remain, while suppressing unstable short-wavelength fluctuations unsupported by the observations.

Damped methods are conceptually important for Iran because the reviewed studies repeatedly identify regional zonation. Central Iran was divided into eight zones with orientations ranging from N006° to N081° (Sheikholeslami et al., 2021), and northwestern Iran was divided into 11 zones based on geographic proximity, kinematic homogeneity, tectonic setting, focal-mechanism similarity, and geodetic data (Rahimzadeh et al., 2026). These subdivisions may represent real stress domains, but a damped approach could provide a more continuous test of whether the stress field changes gradually or abruptly across the Iranian Plateau.

SATSI, developed by Hardebeck and Michael (2006), and MSATSI, described by Martínez-Garzón et al. (2014), are particularly relevant tools for such analyses. MSATSI provides a MATLAB implementation that combines established stress-inversion procedures with simplified data handling and visualisation. The supplied report does not document the use of SATSI or MSATSI in the ten initially included Iranian studies. They should therefore be presented as methodological comparators or candidates for future reanalysis, not as methods already demonstrated in the Iranian evidence base.

4.6. STRESSINVERSE and Related Iterative Software

The northwestern Iran study by Rahimzadeh et al. (2026) used STRESSINVERSE together with Win-Tensor to analyse 264 focal mechanisms across 11 zones. STRESSINVERSE implements the iterative joint-inversion strategy of Vavryčuk (2014), combining Michael's stress formulation with an instability-based selection of fault planes. It allows the input mechanisms to be provided without prior identification of the true nodal plane and can estimate uncertainty through repeated inversions with noise added to the input mechanisms.

This workflow is well suited to a heterogeneous region in which fault-plane ambiguity is substantial and the stress field may vary spatially. The use of two software packages in the northwestern Iran study also provides an opportunity for cross-method comparison. However, agreement between two implementations does not necessarily establish absolute accuracy if both rely on similar assumptions or the same focal-mechanism catalogue. The review should therefore record whether the study compared stress orientations, stress ratios, misfits, and confidence intervals across methods, rather than reporting only that both methods were applied.

4.7. Right Dihedron and Rotational Optimisation

Rashidi and Derakhshani (2022) used the Right Dihedron method and Rotational Optimization method to analyse focal mechanisms across northern Iran. The Right Dihedron approach identifies stress orientations compatible with the polarity or slip constraints of focal mechanisms, while rotational optimisation searches for the stress orientation that maximises agreement between observed mechanisms and the predicted faulting regime. The source report states that the two methods produced no significant difference in the resulting stress field, supporting the stability of the northern Iran interpretation.

The comparison is valuable because method agreement provides an internal robustness test. Nevertheless, the absence of a significant difference should be interpreted in relation to the spatial scale and uncertainty of the two solutions. Northern Iran was divided into 21 networks, and the stress field includes markedly different orientations in the Alborz and Talesh. Therefore, agreement between methods at the regional level should not be taken to mean that every individual network has a uniquely resolved stress tensor.

4.8. Uncertainty, Misfit, and Data Dependence

Stress-inversion results should be reported with confidence regions or uncertainty estimates for principal-stress orientations and, where possible, the stress-shape parameter. Bootstrap resampling is a common method for evaluating the sensitivity of a solution to the composition of the focal-mechanism dataset (Michael, 1987; Vavryčuk, 2014). Noise-perturbation approaches can additionally test the effect of uncertainty in strike, dip, and rake. The magnitude and direction of uncertainty should be reported separately for each principal axis because the axes are not necessarily constrained equally.

The Iranian studies demonstrate uneven but informative use of quality metrics. Gillard and Wyss (1995) reported misfit angles of 2°–5°. Khanban et al. (2021) reported shape-ratio errors below 6% before and 7.2% after excluding dependent events, and noted that the maximum principal stress orientation was less uncertain than the other principal axes. The increase in error after removing dependent events illustrates the trade-off between statistical independence and sample size. In northern Iran, the agreement between Right

Dihedron and Rotational Optimization provided a methodological consistency check (Rashidi & Derakhshani, 2022).

Dependent events require particular attention. Aftershock sequences may contain many mechanisms generated within a restricted fault volume and stress environment. Their inclusion can improve local resolution but may overweight one event sequence in a regional inversion. The review should therefore record whether studies removed dependent events, declustered the catalogue, or compared solutions before and after declustering. The Zagros study provides a direct precedent for this type of sensitivity analysis (Khanban et al., 2021).

4.9. Implications for Comparing Iranian Studies

The reviewed methods do not estimate exactly the same quantities with identical assumptions. A reported maximum horizontal compressive direction may be robust even when the stress-shape parameter is poorly resolved. Likewise, a province-scale orientation may represent an average across several local stress domains. Direct comparison should therefore require harmonisation of azimuth conventions, principal-stress ordering, spatial support, event magnitude and depth ranges, nodal-plane treatment, and uncertainty measures.

For the present review, methodological quality should be evaluated using six criteria: transparency of the focal-mechanism dataset; specification of the inversion algorithm; treatment of nodal-plane ambiguity; evidence for spatial stress homogeneity; reporting of misfit and uncertainty; and reproducibility of the input data and computational workflow. Studies that omit one or more of these fields should not automatically be rejected, but their conclusions should be assigned lower evidentiary confidence. The final synthesis should distinguish robust orientations supported by multiple methods or independent geodetic observations from results based on small, clustered, or incompletely documented datasets.

V. Regional Synthesis of Stress Regimes from Focal Mechanism Inversions

5.1. Zagros Fold-Thrust Belt

The Zagros Fold-Thrust Belt (ZFTB), marking the northern margin of the Arabian plate and extending over 2000 km from the Oman Line to southeastern Turkey, represents the most prominent expression of ongoing Arabia-Eurasia collision in Iran (Khanban et al., 2021; Mahbaz et al., 2022). Stress tensor inversion of earthquake focal mechanisms has revealed a spatially heterogeneous stress field characterised by a horizontal to sub-horizontal maximum principal stress axis (σ_1) with significant along-strike variations (Khanban et al., 2021).

5.1.1. First-Order Stress Characteristics

The present-day stress field across the ZFTB is defined by a NE-SW to NNE-SSW orientation of the maximum horizontal compressive stress (SHmax), consistent with the current convergence direction between the Arabian plate and the Iranian micro-continent (Khanban et al., 2021). Khanban et al. (2021) demonstrated that the compressional stress direction averages NNE-SSW, with a gradual counterclockwise rotation along the belt's strike that is spatially compatible with changes in Arabian-Eurasian convergence paths. This spatial variation reflects the curvature of the collision zone and the changing obliquity of plate convergence along the Zagros arc.

The tectonic regime across the ZFTB is predominantly transpressional (oblique), accommodating both shortening and strike-slip motion (Khanban et al., 2021). The belt was subdivided into seven subzones on the basis of stress field heterogeneity, with shape ratio errors of less than 6% before and 7.2% after excluding dependent events. The orientation of σ_1 showed the lowest uncertainty compared to intermediate (σ_2) and minimum (σ_3) principal stress axes, suggesting that the maximum compressive stress direction is the most robustly determined parameter (Khanban et al., 2021).

5.1.2. Detailed Regional Subdivision

A comprehensive analysis of 898 earthquake focal mechanisms subdivided into 32 subsets (averaging ~28 focal mechanisms per subset) revealed three distinct stress domains along the ZFTB (Nouri et al., 2023):

Southern Domain: The wrench-compressional regime in the southern domain shows a tendency toward pure compression, with low stress ratio values (<0.2) allowing interchange of σ_2 and σ_3 stress axes in 19 of 32 subsets (Nouri et al., 2023). This stress state is consistent with the active shortening accommodated by the Main Zagros Thrust and associated fault systems.

Central Domain: Similar to the southern domain in its wrench-compressional character, the central domain exhibits spatial variations in the relative magnitudes of principal stresses (Nouri et al., 2023). The low stress ratio indicates that the stress state is close to the boundary between compressional and transpressional regimes, with σ_2 and σ_3 becoming nearly equal in magnitude.

Northern Domain: The northern domain displays a more pronounced strike-slip component, reflecting the increasing influence of oblique convergence and the transition toward the collision zone's termination in southeastern Turkey (Nouri et al., 2023).

5.1.3. Western Fars Subregion

Lacombe et al. (2006) conducted a detailed stress analysis of the Western Fars region, documenting a combined strike-slip and thrust regime with SHmax orientation of N020°–030°. The study identified a low differential stress ratio, accounting for the combination of strike-slip and thrust mechanisms through σ_2/σ_3 permutations. This stress state reflects the accommodation of shortening modes changing from partitioned deformation in the western central Zagros to nonpartitioned deformation in the eastern Zagros (Lacombe et al., 2006).

The Western Fars region shows evidence of stress deviations or block rotations related to the strike-slip fault system, with first-order stability of the collision-related stress state since approximately 5 Ma (Lacombe et al., 2006). This indicates that Arabia-Eurasia convergence has been accommodated by distributed deformation involving both shortening and strike-slip motion, rather than by localised partitioning.

5.1.4. Dezful Embayment Case Study

Mahbaz et al. (2022) investigated the state of stress in the Dezful Embayment using two complementary datasets: petrophysical data from 25 wells (3–4 km depth) and 108 earthquake focal mechanisms occurring on blind active basement faults (5–20 km depth). Formal stress inversion of the focal mechanisms demonstrates a compressional stress state ($A\varphi = 2.0–2.2$) in the basement, with SHmax direction of 37° ± 10°—nearly perpendicular to the strike of most faults in the region (Mahbaz et al., 2022). This orientation is consistent with the NE-SW convergence direction of the Arabian plate.

The seismologically determined basement stress state contrasts with the shallow stress regime revealed by borehole geomechanics analysis, which indicates a normal/strike-slip regime—a result that may be evidence of stress decoupling due to the existence of salt layers (Mahbaz et al., 2022). This decoupling has important implications for seismic hazard assessment, as it suggests that basement earthquakes may not be directly transmitted to the surface, consistent with the low seismicity level observed in the sedimentary cover of the Dezful Embayment.

The stress inversion results also align with Coulomb faulting theory predictions: the N-S strike-slip basement Kazerun Fault System has an unfavourable orientation for slip in a reverse fault regime with SW-NE SHmax orientation (Mahbaz et al., 2022). This explains why the Kazerun Fault System, despite being a major tectonic feature, exhibits lower seismic activity than would be expected for a fault of its size.

5.2. W-Zagros Kermanshah Region

Navabpour et al. (2008) reconstructed the stress state evolution in the W-Zagros Kermanshah region, documenting a significant temporal transition from a Miocene-Pliocene syn-folding compressional regime to a Pliocene-Recent post-folding strike-slip system. The stress field experienced a major anticlockwise reorientation of the horizontal σ_1 stress axis from NE-SW to N-S, reflecting a transition from thin- to thick-skinned deformation under oblique plate convergence (Navabpour et al., 2008).

This temporal evolution is interpreted in terms of a southwestward shift of deformation partitioning during the final Pliocene collisional reorganisation (Navabpour et al., 2008). The region's stress history thus provides a window into the changing kinematics of the Arabia-Eurasia collision, where early-stage shortening accommodated by thin-skinned thrusting gave way to later-stage strike-slip faulting as the deformation style evolved.

5.3. Central Iran

5.3.1. First-Order Stress Field

Central Iran, a region of complex intracontinental deformation between the Zagros and Alborz mountain belts, exhibits a first-order stress field with a N029°E NE-SW SHmax orientation corresponding to a general compressive tectonic regime (Sheikholeslami et al., 2021). This orientation is related to Arabia-Eurasia convergence and is confirmed by geodetic measurements (Sheikholeslami et al., 2021).

Sheikholeslami et al. (2021) compiled 103 focal mechanisms from the Global Centroid Moment Tensor Project (GCMT), Harvard University (HRVD), and the International Seismological Center (ISC). Stress inversion of all shallow focal depths using both Win-Tensor and the modified SLICK method yielded similar results for horizontal stress axes orientations and tectonic regimes, providing confidence in the stress field determination.

5.3.2. Second- and Third-Order Stress Fields

To reconstruct the second- and third-order stress fields, the study area was subdivided into eight zones on the basis of structures, relatively similar focal mechanisms, and relatively homogeneous deformation (Sheikholeslami et al., 2021). For each zone, reduced stress tensors were obtained, revealing significant spatial variability: SHmax directions ranging from N006° to N081° across different zones, with variable tectonic regimes. Deformation mechanisms include solid block rotation between strike-slip and thrust faults, vertical rotation of fault-bounded blocks, escape tectonics, block extrusion, and strain partitioning (Sheikholeslami et al., 2021).

The first-order NE-SW stress field accommodates shortening within Central Iran and enables right-lateral movement along N-S faults as well as left-lateral movement along E-W faults (Sheikholeslami et al., 2021). The second- and third-order stress fields, with their variable orientations and tectonic regimes, are responsible for the complex pattern of block rotations and strain partitioning observed in the region.

This multi-scale stress field characterisation demonstrates that while the first-order stress field is dominated by the Arabia-Eurasia collision, local deformation is controlled by the geometry and kinematics of individual fault systems and crustal blocks (Sheikholeslami et al., 2021).

5.4. Northwestern Iran

5.4.1. First-Order Stress Characteristics

Northwestern Iran, one of the most seismically active regions in the world, is situated at the complex tectonic intersection of the Arabian, Anatolian, and Eurasian plates (Rahimzadeh et al., 2026). The region's stress field was investigated by Rahimzadeh et al. (2026) using 264 earthquake focal mechanisms from 1964 to 2024, making this the most comprehensive focal mechanism dataset analysed in the Iranian stress inversion literature.

Stress inversion of all focal mechanisms indicates a first-order stress field with an NNW-SSE SHmax orientation (N162°) corresponding to a general strike-slip tectonic regime (Rahimzadeh et al., 2026). This orientation is directly related to Arabia-Eurasia convergence and accommodates shortening and strike-slip movement along both NW-trending and NE-trending strike-slip faults.

5.4.2. Multi-Zonal Subdivision

The study area was subdivided into 11 distinct zones based on geographical proximity, kinematic homogeneity, tectonic setting, relatively similar earthquake focal mechanisms, and geodetic data (Rahimzadeh et al., 2026). This detailed subdivision revealed the presence of second- and third-order stress fields with significant lateral variations, including four stress regime categories: Strike-slip (SS), normal faulting (NF), transpressional (TS), and transpressive (TF), with SS being the most common (Rahimzadeh et al., 2026).

Methodological consistency was demonstrated by comparing STRESSINVERSE and Win-Tensor outputs, which showed an average difference in σ_1 orientations of 3.4° and in SHmax orientations of 11.5° (with maximal values of 37° and 32° for Zones 9 and 10, respectively) (Rahimzadeh et al., 2026).

5.4.3. Deformation Mechanisms

The stress field heterogeneity in northwestern Iran is attributed to several interacting mechanisms (Rahimzadeh et al., 2026):

Underthrusting of the rigid South Caspian Block: The aseismic South Caspian Block acts as an indenter, creating local stress perturbations that modify the regional stress field.

Block rotation: Rotation of crustal blocks between strike-slip faults accommodates convergence through vertical-axis rotations.

Escape tectonics: Northward extrusion of crustal material in response to plate convergence.

Strain partitioning: Accommodation of oblique convergence through sub-parallel thrust and strike-slip faults.

5.4.4. North Tabriz Fault System

Salmanian et al. (2024) focused specifically on the stress field surrounding the North Tabriz Fault, analysing 35 earthquake focal mechanisms from the Global Centered Moment Tensor catalogue and the Iranian Seismological Center. Using both Michael's linear inversion method and the iterative joint inversion method (Vavryčuk, 2014), they found that the iterative joint inversion method proved more accurate in determining stress fields and principal stress orientations (Salmanian et al., 2024).

The inversion revealed: σ_1 orientation with a trend of 146.08° and plunge of 3.24° (sub-horizontal); σ_2 orientation with a trend of 293.51° and plunge of 86.14° (nearly vertical); σ_3 orientation with a trend of 55.97° and plunge of 2.06° (sub-horizontal); and SHmax orientation of $\alpha = 3.787°$ (approximately N-S) (Salmanian et al., 2024). These results indicate a strike-slip to transpressional tectonic regime in the vicinity of the North Tabriz Fault, with predominant right-lateral strike-slip motion aligned with the prevailing regional tectonic regime.

5.5. Northern Iran: Alborz-Talesh-Kopeh Dagh

5.5.1. Regional Stress Field around the South Caspian Basin

Nouri et al. (2024) conducted a comprehensive stress inversion study around the South Caspian Basin (SCB), encompassing the Kopeh Dagh, Alborz, Talesh, eastern Greater Caucasus mountain belts, the Apsheron sill, and the Balkhan-Ashkabad fault zone. The study applied the iterative joint stress inversion method (Vavryčuk, 2014) to 410 mainshock focal mechanisms that occurred over 69 years, significantly improving upon previous studies that used limited focal mechanism datasets (Nouri et al., 2024).
The orientation of SHmax is NE to NNE in the Kopeh Dagh, Alborz, Talesh, and Ashkabad-Balkhan fault zones, rotating to NNE-N in the Greater Caucasus (Nouri et al., 2024). This orientation relative to the Arabian-Eurasian convergence direction indicates that the oblique convergence-derived tectonic stress is the primary contributor to the total stress and deformation in this region.

5.5.2. Alborz Range

Rashidi and Derakhshani (2022) analysed northern Iran's stress field using 79 focal mechanisms (Mw 4–7.4) from multiple data sources (GCMT, IIEES, IRSC, ISC, ZUR_RMT, UPIES). The Alborz range exhibits an N35.5°E (NNE-SSW) compressional direction, which is consistent with the formation of the Alborz-Talesh range due to the collision of Eurasia with Central Iran and Arabia (Rashidi & Derakhshani, 2022).
The tectonic regime in the Alborz is characterised by oblique shortening, with slip partitioning on sub-parallel thrust and strike-slip faults (Rashidi & Derakhshani, 2022). The faulting breakdown for northern Iran shows: thrust 49.37%; strike-slip 39.24%; thrust with strike-slip component 2.53%; normal 1.27%; and unknown 7.59%. This distribution confirms the slip partitioning mechanism of oblique shortening on sub-parallel thrusts and strike-slip faults, accommodating both shortening parallel to the convergence direction and lateral displacement due to the oblique plate motion (Rashidi & Derakhshani, 2022).

5.5.3. Talesh Mountains

The Talesh Mountains, forming the western boundary of the South Caspian Basin, exhibit a markedly different SHmax orientation of N104°E (WNW-ESE) (Rashidi & Derakhshani, 2022). This orientation contrasts with the NNE-SSW orientation in the Alborz, reflecting local stress perturbation due to the underthrusting of the rigid South Caspian Block.
The Talesh region also shows the highest seismic-to-geodetic moment rate ratio (57.3), indicating that most elastic energy in this region has been released seismically (Rashidi & Derakhshani, 2022). This high ratio suggests that the Talesh Mountains are an area of active seismic deformation where elastic strain is efficiently released through earthquakes, rather than accumulating for future large events.

5.5.4. Kopeh Dagh

The Kopeh Dagh, forming the northeastern boundary of the Iranian Plateau, shows a NE-SHmax orientation consistent with the broader regional stress field (Rashidi & Derakhshani, 2022; Nouri et al., 2024). However, the seismic-to-geodetic moment rate ratio for the western Kopeh Dagh is only 0.3, indicating that most elastic energy remains stored (Rashidi & Derakhshani, 2022). This low ratio suggests that aseismic deformation or accumulated elastic strain may release through future earthquakes, with implications for seismic hazard assessment.

5.6. Eastern Iran: Lut and Tabas Blocks

5.6.1. Tabas Block

Zamani (2011) investigated the state of stress in the northern Tabas block using 60 focal mechanisms from the 1978 Tabas earthquake sequence (magnitude range 1.5–3.79) sourced from Berberian's catalogue, the Geological Survey of Iran, and the University of Cambridge. Stress inversion using the Angelier method (implemented in INVGLI software) revealed: SHmax orientation of 226°–237° (NE-SW); a thrusting regime with vertical σ_3; and a stress ratio $\varphi = 0.5$, indicating small differences between principal stress differences and small deviatoric stress (Zamani, 2011).
The NE-SW compression is consistent with the broader Arabia-Eurasia plate convergence and with independent information on active plate convergence (Zamani, 2011). The consistency between basement and sedimentary cover stress regimes suggests coupling along metamorphic rock layers, implying that deformation is transmitted from basement structures to the sedimentary cover without significant decoupling.
The earthquake activity in the Tabas block is controlled by NE-SW compression near concealed Quaternary thrust faults, with the 1978 Tabas earthquake (Mw 7.4) representing the most prominent expression of this stress regime (Zamani, 2011).

5.6.2. West and South Lut Block

Rashidi et al. (2019) analysed the stress field in the West and South Lut block using focal mechanism inversion (FMSI method) and geodetic data. The study revealed: SHmax orientation of ~N19°E; a compressional strike-slip tectonic regime; and a faulting breakdown of strike-slip 43.2%, thrust 38.6%, and unknown/oblique 18.2% (Rashidi et al., 2019).

The tectonic convergence in the Lut block is accommodated not only by fault motions but also by rotation of blocks bounded by faults, with maximum rotation rates observed near major right-lateral strike-slip fault systems including Sabzevaran, Gowk, Nayband, Bam, Kuhbanan, and Kahurak (Rashidi et al., 2019). This block rotation mechanism reduces the need for large strike-slip offsets on individual faults and accommodates convergence through distributed deformation.

Stress inversion analyses of the western Lut block fault system reveal that the second principal stress axis (σ_2) is nearly vertical, which is characteristic of strike-slip regimes (Rashidi et al., 2019). The primary mechanism of the Nayband-Gowk-Sabzevaran system is right-lateral strike-slip with a reverse component, consistent with the transpressional regime documented across the region.

5.6.3. Rigan Area and Eastern Lut Boundary

A detailed stress inversion of 99 focal mechanisms around the Lut block reveals NE-SW direction of the maximum horizontal compression (σ_1), with some degree of deflection in their directions (Gillard & Wyss, 1995). The trend of the σ_1 stress axis varies from N051°E in the middle part of the East Lut fault system, through N066°E in the Nosrat-Abad and Kahurak fault systems, to N077°E in the Rigan area (Gillard & Wyss, 1995).

There are long-lasting local deviations in the stress state along the eastern and southeastern edges of the Lut Block, where stresses are controlled by the geometry and kinematics of the East Lut fault system and its southern splays (Gillard & Wyss, 1995). However, in the western and southwestern boundaries of the block (Jebal-e-Barez Mountains), the state of stress nearly follows the direction of the Arabia-Eurasia convergence, indicating that far-field stress dominates in this region.

5.7. Iran-Wide Synthesis

5.7.1. Gillard and Wyss (1995)

Gillard and Wyss (1995) performed a stress tensor inversion for Iran using 111 focal mechanisms ($4.4 < M < 8$) and regional subsets with volumes of a few hundred kilometres. Using the method of Gephart and Forsyth, they obtained average misfits ranging from 2° to 5°. Based on test inversions of synthetic data with known misfits, they demonstrated that these misfits can be attributed solely to inaccuracies of less than 10° in fault plane solutions (Gillard & Wyss, 1995).

The study proposed a general criterion that stress inversions with misfits smaller than 6° can be accepted as meaningful—a guideline that has been widely adopted in subsequent Iranian stress studies (Gillard & Wyss, 1995).

5.7.2. Key Insight: Earthquake Size-Stress Relationship

A particularly important finding from Gillard and Wyss (1995) is the relationship between earthquake size and stress field orientation. The study demonstrated that smaller earthquakes occur on faults that are favourably oriented for failure in the prevailing stress field, whereas larger events (M>7) rupture near-vertical strike-slip faults that are unfavourably oriented but weak (Gillard & Wyss, 1995). This weakness causes failure under low ratios of shear to normal stress.

This observation has profound implications for understanding earthquake mechanics and seismic hazard in Iran (Gillard & Wyss, 1995): small earthquakes reveal the regional stress field by activating faults that are optimally oriented for failure; large earthquakes occur on weak faults that deviate from the optimal orientation, requiring a different mechanism of failure that does not follow the Wallace-Bott hypothesis. The distinction between small and large earthquake behaviour suggests that extrapolating from the distribution of small earthquakes to predict large-earthquake hazard requires careful consideration of fault strength heterogeneity and the existence of weak, unfavourably oriented faults.

5.8. Regional Stress Field Synthesis

The regional stress field analyses across Iran reveal a coherent pattern of maximum horizontal compressive stress orientations that vary systematically across tectonic provinces. Table 1 presents a comprehensive synthesis of SHmax orientations, tectonic regimes, and key characteristics for each region derived from focal mechanism stress tensor inversion studies.

Table 1: SHmax Orientations and Tectonic Regimes by Region

Tectonic Domain Region	SHmax*SHmax* Orientation	Dominant Tectonic Regime	Key Deformation Mechanisms Observations	Primary Reference(s)
Zagros F.T.B. (General)	NNE–SSW (gradual CCW rotation)	Transpressional Wrench-Compressional	Along-strike domain variation (Southern, Central, Northern); strain partitioning.	Khanban et al. (2021); Nouri et al. (2023)
Dezful Embayment	37° ± 10° (Basement)	Compressional (Basement) Normal-SS (Shallow)	Stress decoupling via Hormuz salt; Kazerun Fault unfavourably oriented.	Mahbaz et al. (2022)
Western Fars	N020°–030°	Strike-slip Thrust	σ2/σ3*σ2*/*σ3* permutations; stable since ~5 Ma; transition to non-partitioned deformation.	Lacombe et al. (2006)
W-Zagros (Kermanshah)	N–S (Present) / NE–SW (Miocene)	Strike-slip (Present) Compressional (Past)	Anticlockwise rotation; thin- to thick-skinned deformation transition.	Navabpour et al. (2008)
Central Iran	N029°E (Range: N006°–N081°)	Compressive Thrust	8 zones; block rotation, escape tectonics, extrusion; consistent with geodetic GPS.	Sheikholeslami et al. (2021)
Northwestern Iran	N162° (NNW–SSE)	Strike-slip	11 zones; South Caspian Block underthrusting; escape tectonics.	Rahimzadeh et al. (2026)
North Tabriz Fault	~N–S (α=3.787°*α*=3.787°)	Strike-slip Transpressional	Localized transpressional corridor; σ1*σ*1 trend 146.08°, plunge 3.24°.	Salmanian et al. (2024)
Alborz Range	N35.5°E (NNE–SSW)	Oblique Shortening	Slip partitioning (49% thrust, 39% SS); high seismic energy release.	Rashidi & Derakhshani (2022)
Talesh Mountains	N104°E (WNW–ESE)	Oblique Shortening	Local perturbation due to rigid South Caspian Block underthrusting/rotation.	Rashidi & Derakhshani (2022)
South Caspian Basin	NE to NNE	Oblique / Thrust	Broad oblique convergence; low seismic/geodetic moment ratio (0.3) indicates stored strain.	Nouri et al. (2024); Rashidi & Derakhshani (2022)
Northern Tabas Block	226°–237° (NE–SW)	Thrusting	ϕ=0.5*ϕ*=0.5; basement-cover coupling; concealed Quaternary thrusts.	Zamani (2011)
West & South Lut Block	~N19°E	Compressional Strike-slip	43% SS, 39% Thrust; rigid block rotation near Gowk, Bam, Sabzevaran faults.	Rashidi et al. (2019)
Eastern Lut Boundary	N051°E to N077°E	Strike-slip	Local deviations controlled by East Lut fault splays (Rigan area).	Source Data (Lut Synthesis)

VI. Discussion

6.1. First-Order Stress Field: Arabia-Eurasia Collision as Primary Control

The systematic synthesis of focal-mechanism stress-tensor inversion studies across Iran demonstrates that the active stress field is fundamentally controlled by the Arabia-Eurasia collision but is substantially modified by regional and local tectonic processes, producing a spatially heterogeneous pattern of stress orientations and faulting regimes. The first-order pattern is broadly compatible with Arabia-Eurasia convergence, as confirmed by GPS measurements (Vernant et al., 2004; Reilinger et al., 2006). However, the expression of that stress varies from thrusting in northern Tabas (Zamani, 2011), through transpression and mixed shortening in the Zagros (Khanban et al., 2021; Nouri et al., 2023), to compressional strike-slip deformation in the Lut Block (Rashidi et al., 2019) and dominant strike-slip deformation in northwestern Iran (Rahimzadeh et al., 2026). Northern Iran displays oblique shortening with nearly balanced thrust and strike-slip components (Rashidi & Derakhshani, 2022).

6.2. Second- and Third-Order Stress Field Heterogeneities

The regional results support a hierarchical interpretation of Iran's active stress field. Three mechanisms recur across the regional studies. First, block rotation changes the orientation of local stress relative to the regional convergence vector, as documented in Central Iran (Sheikholeslami et al., 2021), the Lut Block (Rashidi et al., 2019), and northwestern Iran (Rahimzadeh et al., 2026). Second, strain partitioning allows oblique convergence to be distributed between thrust and strike-slip faults, as observed in the Zagros (Khanban et al., 2021), the Alborz (Rashidi & Derakhshani, 2022), and northwestern Iran (Rahimzadeh et al., 2026). Third, underthrusting and escape tectonics generate local perturbations superimposed on the collision-scale field, particularly in northwestern Iran where the rigid South Caspian Block acts as an indenter (Rahimzadeh et al., 2026; Rashidi & Derakhshani, 2022).

6.3. Temporal Evolution of Stress Fields

Temporal evolution of stress fields is documented in western Iran. The W-Zagros Kermanshah region records a transition from Miocene-Pliocene syn-folding compression to Pliocene-Recent post-folding strike-slip deformation, accompanied by anticlockwise reorientation of the horizontal σ_1 axis from NE-SW to N-S, reflecting the evolution from thin- to thick-skinned deformation under oblique plate convergence (Navabpour et al., 2008). Western Fars similarly records a change from NE-SW to N020° compression, interpreted as reflecting stress deviations or block rotations related to strike-slip fault systems (Lacombe et al., 2006). These findings indicate that present-day stress orientations cannot always be interpreted independently of the geological and tectonic history of a region.

6.4. Implications for Earthquake Mechanics and Seismic Hazard

The comparison of seismic and geodetic moment rates reveals strongly heterogeneous patterns of elastic energy release across northern Iran, with ratios varying from 0.3 in the western Kopeh Dagh and South Caspian Basin to 57.3 in Talesh (Rashidi & Derakhshani, 2022). These variations have direct implications for seismic hazard assessment: low ratios indicate stored elastic energy representing future seismic risk, while high ratios suggest efficient seismic release of accumulated strain. High-hazard areas have been identified along the western and eastern segments of the North Alborz, the Royan, Mosha, and Evianaki faults (Rashidi & Derakhshani, 2022), and the Gowk fault segments between Bam and Shahdad (Rashidi et al., 2019).

The relationship between earthquake size and stress field orientation documented by Gillard and Wyss (1995) has profound implications for understanding earthquake mechanics in Iran. Smaller earthquakes occur on faults that are favourably oriented for failure in the prevailing stress field, whereas larger events (M>7) rupture near-vertical strike-slip faults that are unfavourably oriented but weak (Gillard & Wyss, 1995). This observation suggests that extrapolating from the distribution of small earthquakes to predict large-earthquake hazard requires careful consideration of fault strength heterogeneity and the existence of weak, unfavourably oriented faults.

VII. Limitations and Future Directions

7.1. Methodological Heterogeneity

Methodological heterogeneity remains a significant limitation. The reviewed studies differ substantially in focal-mechanism dataset size (60 to 264 mechanisms), inversion methods (Win-Tensor, STRESSINVERSE, Gephart-Forsyth, Angelier, iterative joint inversion), spatial subdivision (8 to 21 zones), and uncertainty reporting. These differences complicate direct cross-study comparison and highlight the need for standardised quality reporting and methodological harmonisation.

7.2. Geographic Coverage Gaps

Significant geographic gaps exist, with Makran and Kopeh Dagh underrepresented in the focal-mechanism stress-inversion evidence base. These regions should not be assigned stress orientations or regimes by interpolation from neighbouring provinces. Makran differs fundamentally from the intracontinental collision domains because it includes active subduction and an accretionary margin (Byrne et al., 1992; Smith et al., 2013). Kopeh Dagh represents a separate range-front and strike-slip system in northeastern Iran (Hollingsworth et al., 2010).

7.3. Data Quality and Accessibility Issues

The current evidence matrix should be treated as preliminary until every included study is verified against its original publication. Full-text verification is essential for confirming the number of focal mechanisms, catalogue provenance, event magnitude and depth criteria, inversion parameters, uncertainty estimates, and the precise meaning of reported stress orientations.

7.4. Future Research Directions

Future research should prioritise standardised quality reporting, expanded geographic coverage, integration of geodetic and structural data, and application of advanced inversion techniques to further refine the national stress-field model for this seismically active region. Priority regions for new studies include the Makran subduction zone, eastern Alborz, and central Kopeh Dagh. Temporal monitoring through repeated inversions over time would allow documentation of stress rotations and transient changes. Adopting common quality reporting standards, including misfit values, stress ratio, confidence intervals, and data selection criteria, would facilitate cross-study comparison and synthesis.

VII. Conclusions

This systematic review of earthquake focal-mechanism stress-tensor inversion studies across Iran demonstrates that the active stress field is fundamentally controlled by the Arabia-Eurasia collision but is substantially modified by regional and local tectonic processes, producing a spatially heterogeneous pattern of stress orientations and faulting regimes. The maximum horizontal compressive stress orientation varies systematically across tectonic provinces: approximately N-S in W-Zagros/Kermanshah and N020°–030° in western Fars (Navabpour et al., 2008; Lacombe et al., 2006), NNE-SSW in the Zagros Fold-Thrust Belt (Khanban et al., 2021), NE-SW (N029°E) in Central Iran (Sheikholeslami et al., 2021), NNW-SSE (N162°) in northwestern Iran (Rahimzadeh et al., 2026), and N35.5°E in the Alborz contrasting with N104°E in the Talesh Mountains (Rashidi & Derakhshani, 2022), while the Tabas and Lut blocks exhibit NE-SW and N19°E orientations, respectively (Zamani, 2011; Rashidi et al., 2019). Tectonic regimes likewise show systematic spatial variation from thrusting in the Tabas Block through transpression in the Zagros to strike-slip deformation in northwestern Iran, with northern Iran exhibiting oblique shortening characterised by nearly balanced thrust (49.37%) and strike-slip (39.24%) faulting (Rashidi & Derakhshani, 2022). These variations are attributed to multiple interacting mechanisms: block rotation, escape tectonics, strain partitioning, and underthrusting of the rigid South Caspian Block, which collectively modify the first-order collision-related stress field. The Zagros synthesis by Nouri et al. (2023) further demonstrates that stress orientations change from NE-SW to NNW-SSE along the belt while the regime varies from wrench-dominated in the north to compressional in the central and southern sectors, with low stress-ratio values (<0.2) in 19 of 32 subsets permitting interchange of σ_2 and σ_3 axes. Temporal evolution of stress fields is documented in western Iran, where the W-Zagros Kermanshah region records a transition from Miocene-Pliocene syn-folding compression to Pliocene-Recent post-folding strike-slip deformation, accompanied by anticlockwise reorientation of the horizontal σ_1 axis from NE-SW to N-S, reflecting the evolution from thin- to thick-skinned deformation under oblique plate convergence (Navabpour et al., 2008). Western Fars similarly records a change from NE-SW to N020° compression, interpreted as reflecting stress deviations or block rotations related to strike-slip fault systems (Lacombe et al., 2006). The comparison of seismic and geodetic moment rates reveals strongly heterogeneous patterns of elastic energy release across northern Iran, with ratios varying from 0.3 in the western Kopeh Dagh and South Caspian Basin to 57.3 in Talesh (Rashidi & Derakhshani, 2022). These variations have direct implications for seismic hazard assessment: low ratios indicate stored elastic energy representing future seismic risk, while high ratios suggest efficient seismic release of accumulated strain. High-hazard areas have been identified along the western and eastern segments of the North Alborz, the Royan, Mosha, and Evianaki faults (Rashidi & Derakhshani, 2022), and the Gowk fault segments between Bam and Shahdad (Rashidi et al., 2019). Methodological heterogeneity remains a significant limitation. The reviewed studies differ substantially in focal-mechanism dataset size (60 to 264 mechanisms), inversion methods (Win-Tensor, STRESSINVERSE, Gephart-Forsyth, Angelier, iterative joint inversion), spatial subdivision (8 to 21 zones), and uncertainty reporting. These differences complicate direct cross-study comparison and highlight the need for standardised quality reporting and methodological harmonisation. Furthermore, significant geographic gaps exist, with Makran and Kopeh Dagh underrepresented in the focal-mechanism stress-inversion evidence base. In conclusion, the Iranian stress field is best interpreted as a first-order Arabia-Eurasia collision signal modified by regional and local tectonic processes. This hierarchical framework provides a robust basis for understanding active deformation, evaluating fault rupture potential, and informing probabilistic seismic hazard assessment. However, future research should prioritise standardised quality reporting, expanded geographic coverage, integration of geodetic and structural data, and application of advanced inversion techniques to further refine the national stress-field model for this seismically active region.

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