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Review

Cretaceous Changes of Strike-Slip Tectonics on the North Pacific Margins: Implications for the Earth's Rotation

Victor P. Nechaev [1,*], Frederick L. Sutherland [2] and Eugenia V. Nechaeva [3]

[1] Far East Geological Institute, Far Eastern Branch, Russian Academy of Sciences, 159, Prospect 100-Letiya, Vladivostok 690022, Russia
[2] Geoscience, Australian Museum, 1 William Street, Sydney, NSW 2010, Australia
[3] Polytechnic Institute, Far Eastern Federal University, Vladivostok 690922, Russia
* Correspondence: nechaev@fegi.ru; Tel.: +7-902-4866273

Abstract: This study reviews the Meso–Cenozoic tectonic paleo-reconstructions for the East Asian and western North American continental margins, focusing on strike-slip tectonics. It follows previous studies by the present and other authors, which investigated the Cretaceous turn of geological evolution (CTGE). They largely studied significant changes in the Earth's mineralization, magmatism and climate. The present study focuses on significant changes related to the Earth's rotation velocity. This question is significant not only for fundamental science, but also for applied geology, because CTGE is marked by abundant ore and energetic resources. The results show domination of sinistral shearing on the NE-oriented Asian margin during the pre-early Cretaceous time that turned to significant development of dextral movements in the mid Cretaceous–Cenozoic time. On the NW-oriented American margin, significant development of sinistral movements in the pre-early Cretaceous time turned to domination of dextral shearing during late Cretaceous and Cenozoic. These tectonic changes indicate the transition of the Earth's rotation from the accelerating towards decelerating regime after CTGE (135–120 Ma). This change may be caused by the transition of the Earth' mass to, and then, away from the polar regions, the processes being related to melting and freezing of the ice caps.

Keywords: sinistral and dextral faulting; major lateral movements; Earth's rotation; Cretaceous turn of geological evolution

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1. Introduction

This study reviews the Meso–Cenozoic tectonic paleo-reconstructions for the East Asian and western North American continental margins, focusing on strike-slip tectonics. It follows our and other previous works [1–5], which investigated the Cretaceous turn of geological evolution (CTGE). They largely studied significant changes in the Earth's mineralization and large igneous provinces [4,5]. A major question of the present study is if this turn was associated with a significant change of the Earth's rotation velocity? If yes, it should be reflected by contemporary changes of strike-slip tectonics on the eastern (NE-oriented) and western (NW-oriented) continental margins of North Pacific. This question is significant not only for fundamental science, but also for applied geology, because CTGE is marked by abundant ore and energetic resources.

Our previous studies [1,2] on the matter suggested that the galactic seasons of the Earth indicate significant changes caused by its distance from the Sun while that star was flying along its elliptical orbit. Under the gravitational influence of a huge mass at the galactic center, the Solar System, including Earth, became extended when it moved closer to the center and then contracted back towards the Sun when it became more distant. Therefore, the galactic winters on the Earth coincided with closer to the galactic center position of the Solar System and vice versa. Galactic winters occurred on the Earth during the Vendian, Carboniferous–Permian and Late Cenozoic periods. These times were characterized by long-term decreases in global temperature and biodiversity, and by the formation of supercontinents. In the warmer galactic seasons like the Jurassic–Cretaceous time, the Earth would have some semblance of Venus conditions with its widespread mafic volcanism, disseminated thicker crust, and dense 'gas-laden' atmosphere. One of the major consequences of this hypothesis is that there are critical points of the Earth's history that were named the turns of geological evolution. The last of them occurred in early Cretaceous (135–120 Ma), when the Earth got the closest to the Sun position and then began moving away from it [2].

A.N. Tretyak [3] applied a similar approach to the interpretation of the geological history of the Earth. He also summarized the previous reviews on the Phanerozoic evolution of major geological processes including paleomagnetism, volcanic activity, climate (particularly glaciations), orogenies, sea level and organic life to synchronize them with the galactic seasonality. As a result, a galactic year was defined with a duration of 215 million years, including a short (30 million years) winter, a long (85 million years) summer, and spring and winter seasons of 50 million years each. The Cretaceous period was placed in the middle of the galactic summer, corresponding to the location of the Solar System in maximum distance from the galactic center. This is where the similarity between our models ends. According to the Tretyak's assumption [3], the galactic seasonality is controlled by passages of the solar system through jets of cosmic dust and 'gas emanations' that are responsible for global cooling during the galactic winters that occurred in Late Cenozoic, Triassic and Silurian–Devonian. The associated processes include intense volcanic and seismic activities, the fast movement of lithospheric plates, an uplift of continents and an increase in the frequency of magnetic reversals. In contrast, the summer-time on the Earth is characterized by a calm geodynamic regime and low magmatic activity, which directly contradicts our hypothesis [2,4,5]. In addition, A.N. Tretyak [3] suggests that the galactic summers were accompanied by deceleration of the Earth's rotation. The latter is caused by a decreased influence of external gravitational, magnetic and electromagnetic fields, a resistance to which could speed up the rotation. This suggestion is the subject of testing in this review.

It is well known that the North Pacific has been surrounded by convergent and transform boundaries indicating oblique interactions of tectonic plates for at least the Meso–Cenozoic time [6,7]. The associated continental margins served as an arena for strike-slip tectonics, with left-lateral shears dominating on the NE-trending East Asian margin, and right-lateral (dextral) shears dominant on the NW-trending American margin. This phenomenon is explained by the permanent equator-oriented forces related to the Earth's rotation that synchronously initiate the right- and left-lateral motions (dextral and sinistral, respectively) of the continental masses [8–11]. The resulting circum-oceanic shear zones do not intersect each other and are associated with the frontal orogenic belts and rear extension structures.

The Earth's rotation is generally decelerating, a state that is caused by the tidal friction related to the gravitational pull of the Moon and, to a lesser extent, the Sun [12,13]. Another process significantly influencing secular changes of the Earth's rotation is the melting and freezing of polar ice caps and the corresponding change of water volumes on continents and in the world ocean. In addition, S. Newcomb [14], M.V. Stovas [15], N.N. Pavlov [16], P.S. Voronov [8,9], V.P. Utkin [10,11] and many other researchers defined that the secular, relatively gradual variations of the Earth's rotation were complicated by 'irregular variations' resulting in multiple transformations of geodynamic regimes on continental margins.

The dynamics of Earth's liquid core can also influence the rotation [17]. However, it is not clear enough actually and, consequently, not discussed in this review.

As V.P. Utkin [10,11] inferred, variations of the Earth's rotation led to differences in development of the global strike-slip zones (Figure 1). The NW-dextral zones are suggested to have been preferentially developed when the rotation slows down (decelerates), while the NE-sinistral zones are preferentially developed when it speeds up (accelerates). In addition, the V.P. Utkin's paleo-reconstructions suggested that the NE-sinistral displacements in the Northern Hemisphere prevailed during the Mezo–Cenozoic time, while the NW-dextral movements dominated during the Paleozoic time, indicating long-term periods of acceleration and deceleration in the Earth's rotation, respectively.

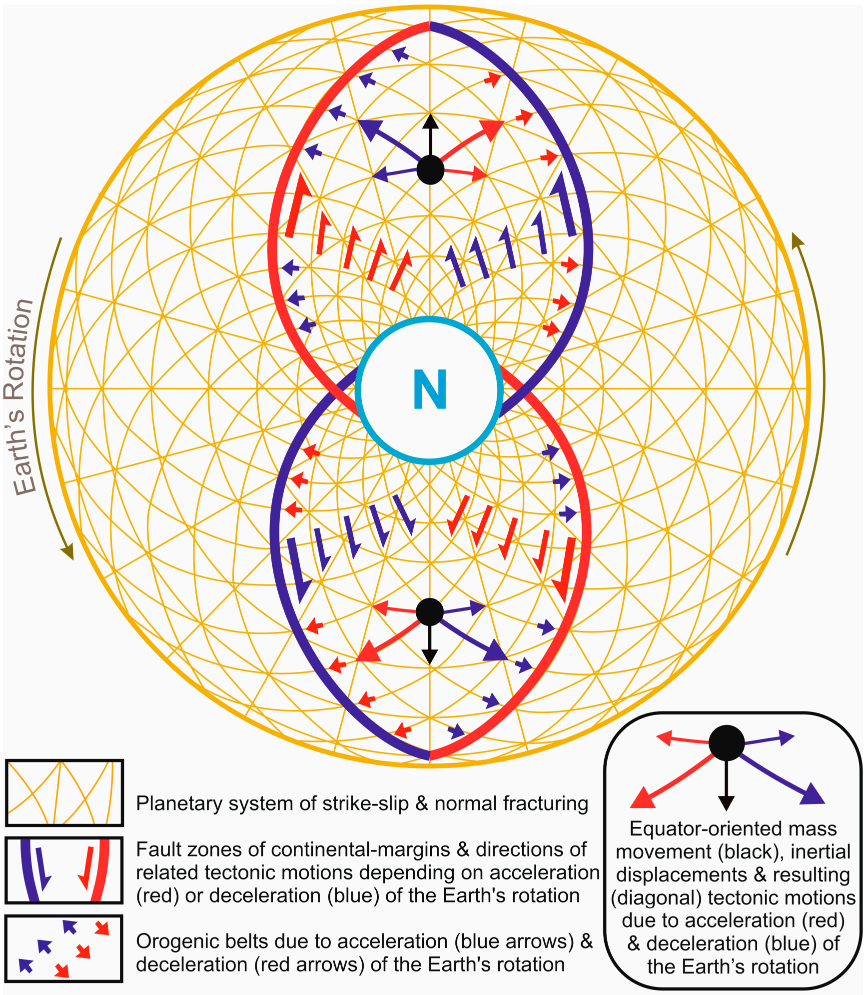

Figure 1. Physical model of an unevenly rotating sphere showing the system of rotation-related planetary fracturing with global shear zones and frontal orogenic belts (modified after [11]).

As will be shown below, the reported tectonic transformations evidence that CTGE consisted not only in some of Earth's approach to the Sun in late Jurassic and early Cretaceous, but also in an anomalous increase of the Earth's rotation velocity.

Note that, in the figures compiled from other works below, many symbols and abbreviations are not explained, since they are not discussed in this review, which is focused on strike-slip faulting traditionally indicated by the arrows pointing in opposite directions.

2. Results

2.1. Strike-Slip Deformations on the East Asian Margin

The most studied tectonic zones on the East Asian margin belong to the Tancheng–Lujiang (Tan–Lu) and Sikhote–Alin fault systems (Figure 2; [18–21]).

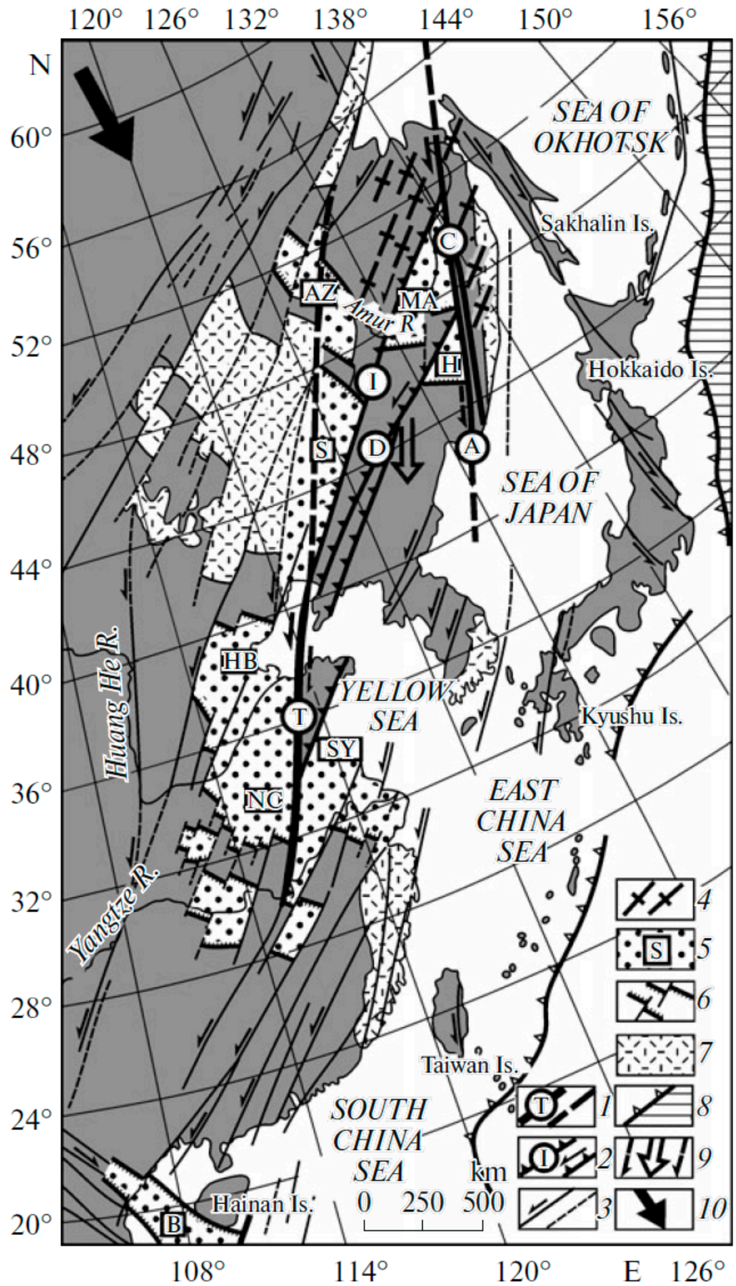

Figure 2. The Tan–Lu and Central Sikhote–Alin sinistral fault systems after [21]. Dashed line indicates suggested and overlapped strike-slip faults.

Most of these faults are sinistral, with the along-fault displacements up to several hundred kilometers and the late Jurassic to early Cretaceous timing that were defined using the paleomagnetic measurements and isotopic geochronology of associated igneous rocks [20–22]. The large-scale sinistral deformations of that time are clearly manifested by the giant S-fold structures, one of which was identified at the northeastern termination of the Tan–Lu system (Figure 3; [23,24]).

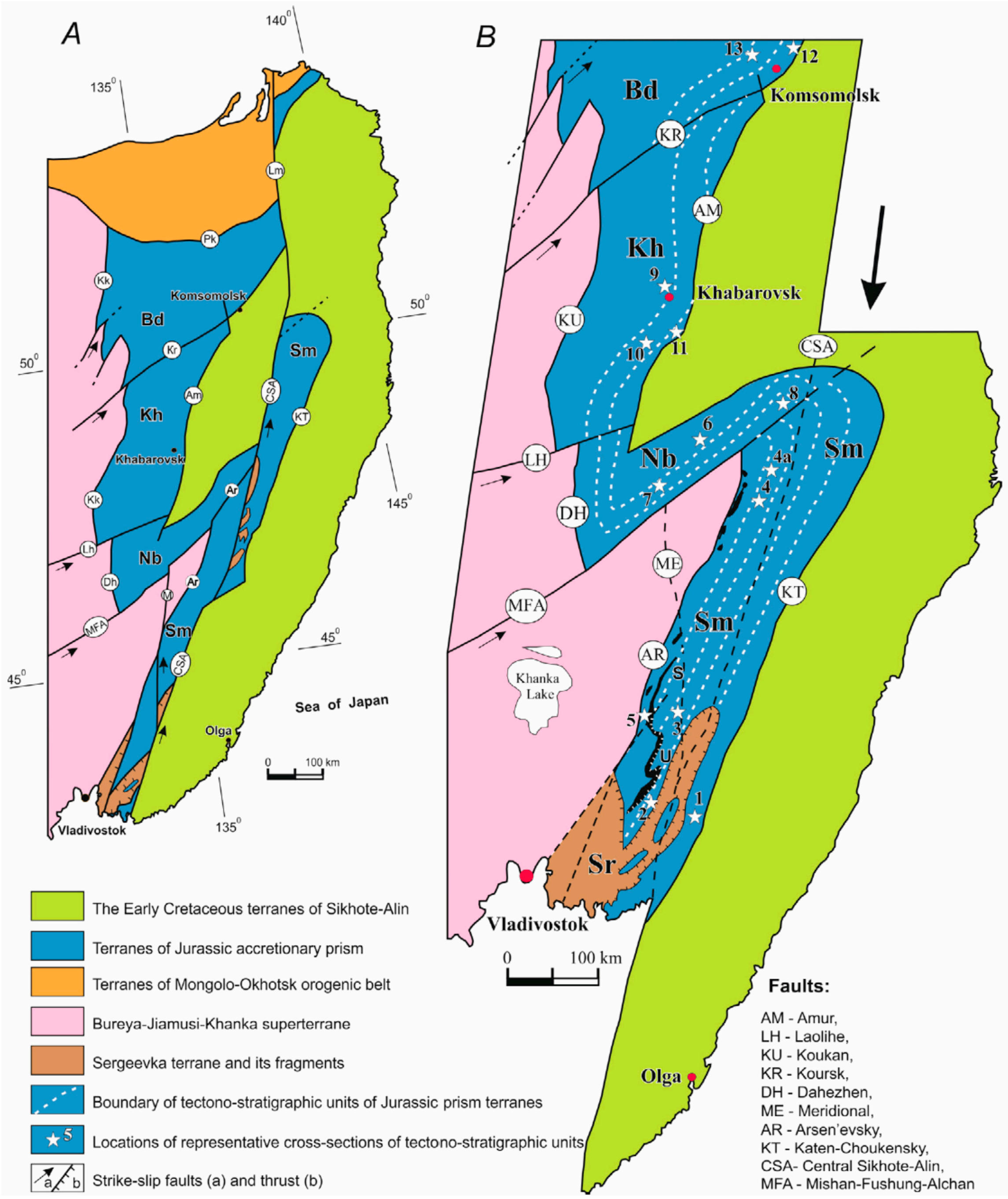

Figure 3. Giant S-fold structure on geological scheme of the Sikhote–Alin Fold Belt (**A**) and tectonic reconstruction at the end of Early Cretaceous (**B**) after [23,24].

In contrast, some dextral NW-trending faults were developed in East Asia during the mid-Cretaceous–Cenozoic time. They were associated with pull-apart basins along both sides of the Tan–Lu system [25]. To the north, dextral movements of Aptian–Albian age formed the so-called Kolyma Loop and South Anyui Suture that together may be considered as a giant Z-fold structure (Figure 4; [26]). Thus, Aptian (113–125 Ma), the time immediately following CTGE (135–120 Ma), may be considered as a proximal date of NE sinistral to NW dextral transformation in East Asia.

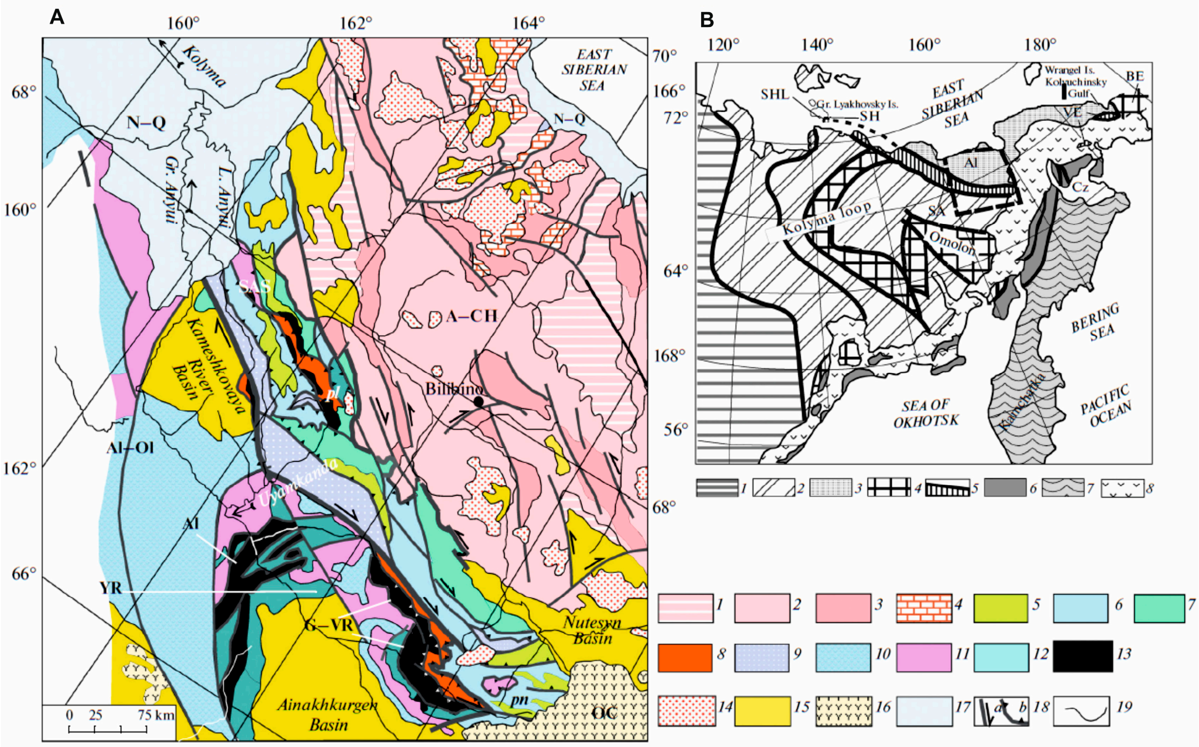

Figure 4. South Anyui Suture and Kolyma Loop on the geological (**A**) and tectonic (**B**) schemes of NE Asia after [26].

Later, the centers of dextral movements shifted southeastward, appearing as the Paleocene–early Eocene shears in the Bohai Basin [27] and the Eocene–Miocene pull-apart basins, including the Yellow Sea [22,28], the Sea of Japan, the Sea of Okhotsk, and the South China Sea [29,30]. These movements are commonly attributed to the Indian–Eurasian collision, which may be due to the late Cretaceous–Paleogene right-lateral displacement along the Ninetyeast transform fault [31]. Another popular explanation is that the Cenozoic dextral movements were related to the NNW-directed subduction of the Pacific to the Eurasian plates [32,33]. At the same time, NE-oriented left-lateral faulting associated with the Paleogene magmatic activity also took place in East Asia, particularly in the eastern Sikhote–Alin Foldbelt, Far Eastern Russia [34]. However, this faulting was minor, related to the major pre-Cenozoic sinistral shearing of regional scale [18,21].

Thus, the strike-slip motions along East Asia were generally reoriented during mid-late Cretaceous, the time following CTGE. This supports our hypothesis, though contradicts Utkin's suggestion [11] that the NE-sinistral displacements in the North hemisphere prevailed during the Mezo-Cenozoic time.

2.2. Strike-Slip Deformations on the Western North American Margin

Western North America is an arena of NW-trending dextral faulting that has dominated since at least the late Cretaceous [35]. This statement is illustrated by Figure 5 [36].

This domination, however, is questionable for the earlier Mesozoic time. Many Jurassic and early Cretaceous paleotectonic studies reconstruct prevailing NW-dextral faulting, while others argue the significant development of sinistral shears. For example, the middle Jurassic to mid-Cretaceous reconstruction by J. Nelson and M. Colpron [35] shows well-developed dextral faults associated with large magmatic bodies and ore deposits of the middle Jurassic to mid-Cretaceous age in the northwestern America (Figure 6).

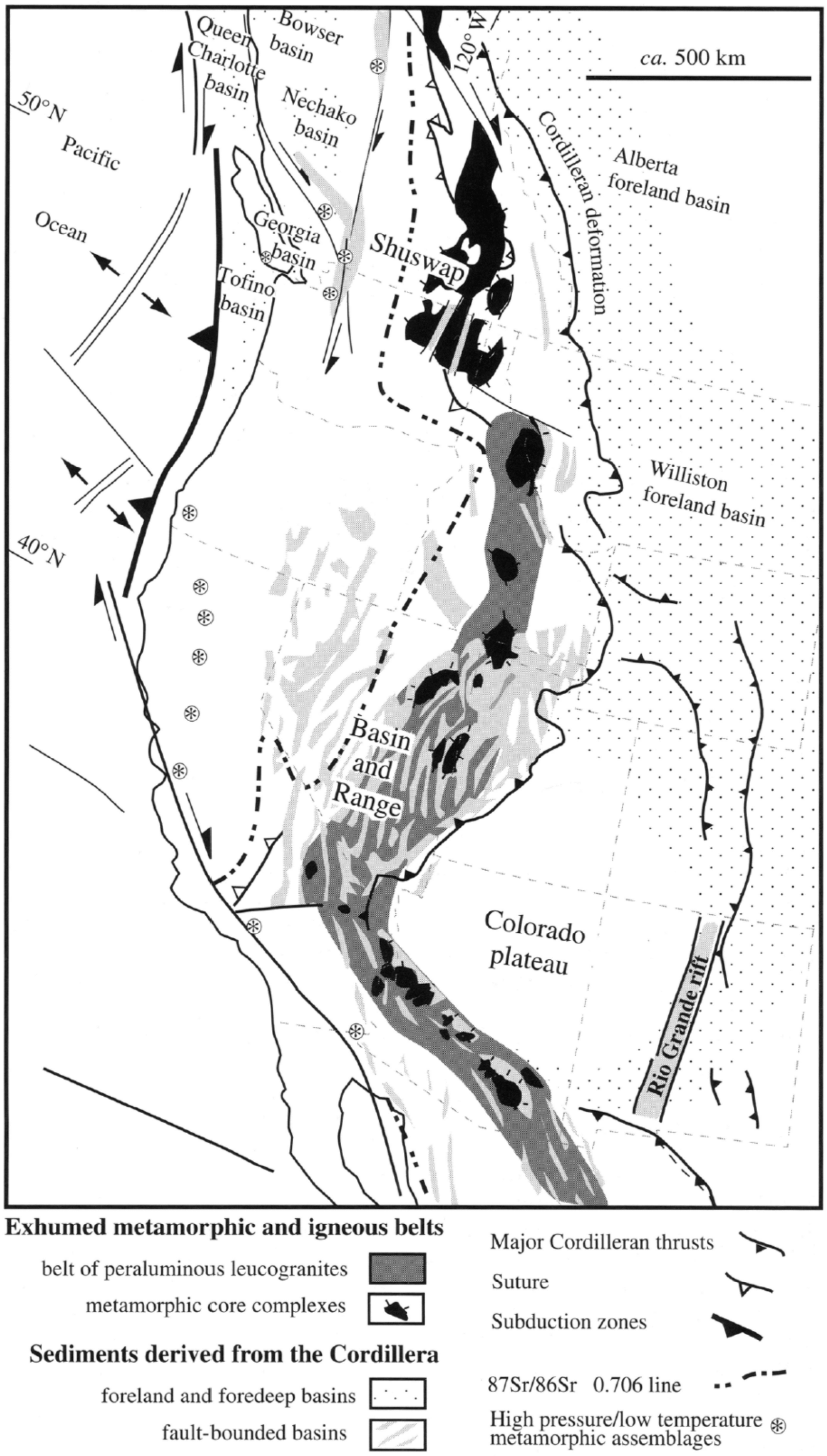

Figure 5. Schematic tectonic map of western North America illustrating the relationship between major Cordilleran tectonic units and metamorphic core complexes formed from late Mesozoic to late Cenozoic time ([36] and references therein).

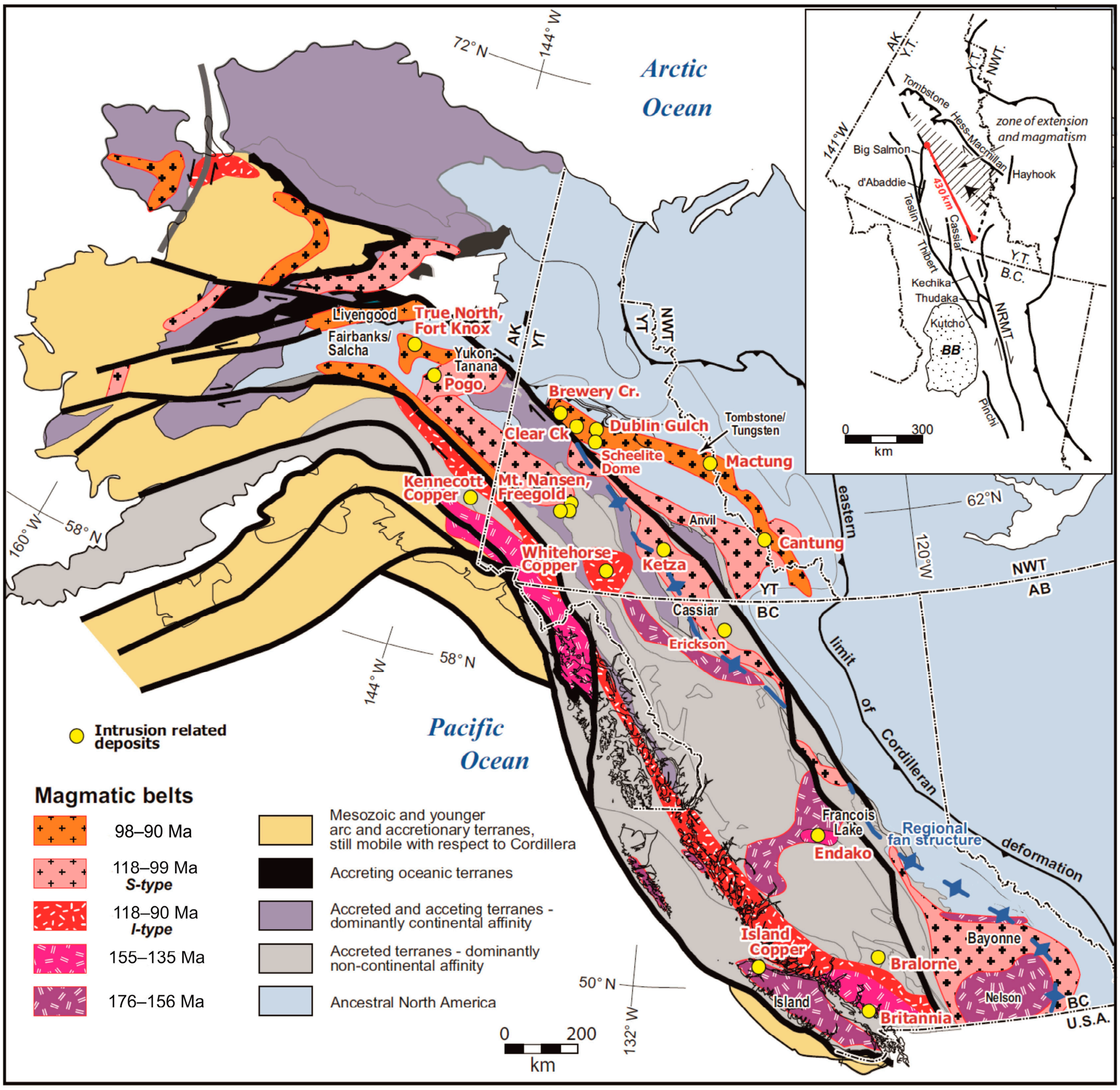

Figure 6. Middle Jurassic to mid-Cretaceous tectonics, magmatism and associated deposits in the Canadian and Alaskan Cordillera after [35]. Inset shows relationship of the Early Cretaceous transcurrent faults and inferred zone of extension and magmatism in northern British Columbia and southern Yukon after [37]. AK, Alaska; YT, Yukon Territory; NWT, North–West Territory; BC, British Columbia; NRMT, the Northern Rocky Mountain Trench; BB, Bowser basin.

In this scheme, the major dextral displacements along the Northern Rocky Mountain Trench (Figure 6) and related faults are inferred to transfer into northwest-directed extension in southeast Yukon and compression along Tombstone thrust in western Yukon, when 430 km of displacement is restored along the Eocene Tintina fault (long dashes). At the same time, this reconstruction includes the minor sinistral shearing. For example, the fault shown in gray in the upper left corner of Figure 7 is not only left-lateral, but also orthogonal to the major right-lateral shears, suggesting its relation to the acceleration of the Earth's rotation.

The paleotectonic studies arguing the Jurassic and early Cretaceous sinistral shearing followed by the late Cretaceous–Cenozoic dextral shearing in western North America are also numerous [38–44]. They can help us to define the time of sinistral-to-dextral strike-slip transformation in western North America.

J.W.H. Monger et al. [38] reported the late Jurassic–early Cretaceous fore- and back-arc rock complexes shifted along the faults, indicating the Early to mid-Cretaceous sinistral transcurrent regime in the Canadian Coast Belt. Later, P.A. Umhoefer [39] and J.L. Nelson with coauthors [40] reconstructed sinistral oblique convergence during the late Jurassic and earliest Cretaceous and suggested a major change in the tectonics of the Cordillera at 125–120 Ma. Sauer et al. [41] and Beranek et al. [42] strongly supported these reconstructions with the U-Pb and Hf isotopic data for zircons extracted from the Jurassic–late Cretaceous arc-magmatic and associated sedimentary rocks (Figure 7).

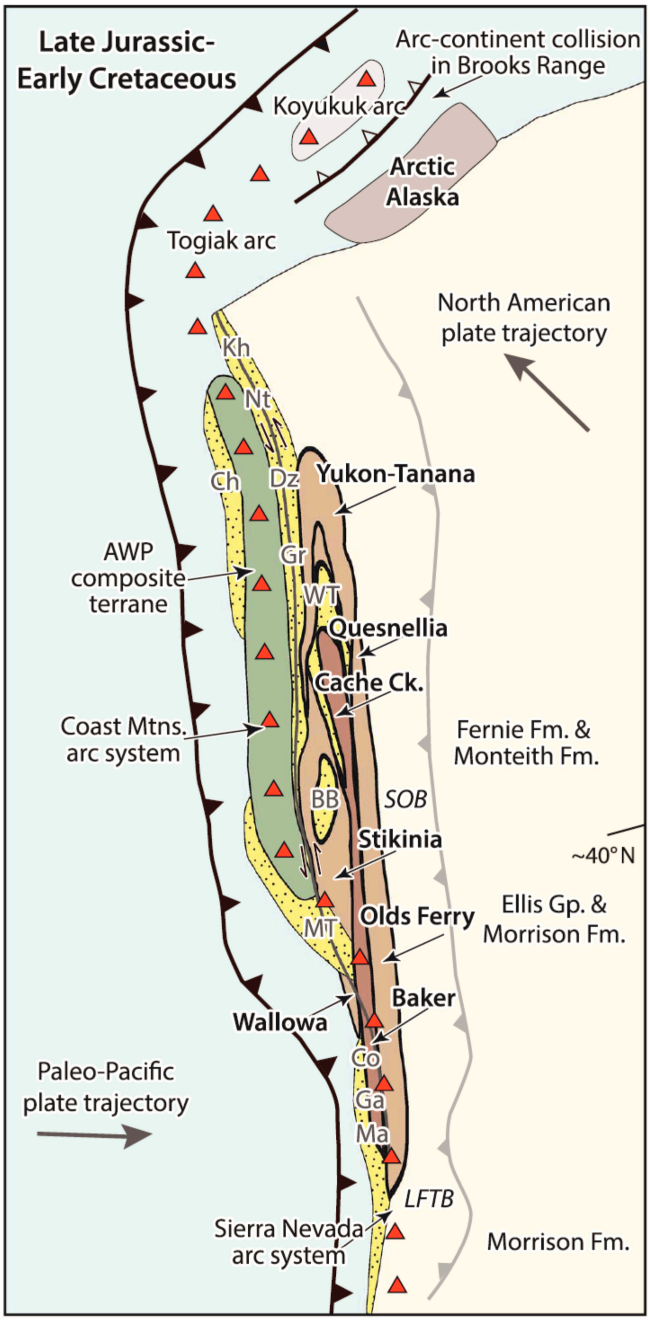

Figure 7. Late Jurassic–Early Cretaceous paleogeographic reconstruction for NW North America modified by Beranek et al. [42] from base map of Nelson et al. [40]. Red triangles represent the inferred axis of Late Jurassic–Early Cretaceous arc magmatism. Note that the major sinistral fault shown in this scheme is NE-oriented (Brooks Range), suggesting its relation to acceleration of the Earth's rotation. See Figure 6 for comparison.

The highly cited work by T.H. Anderson [43] summarized the tectonics of a continent-scale, sinistral transcurrent fault system that had been named the Mexico–Alaska megashear (Figure 8).

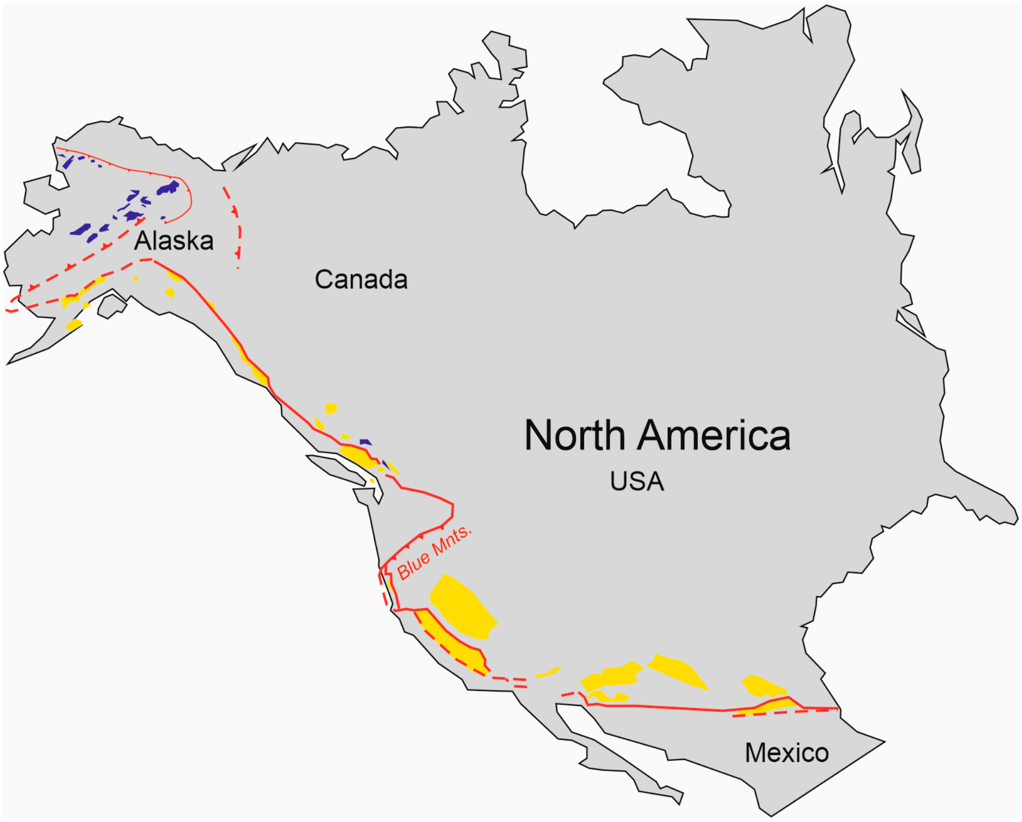

Figure 8. The Mexico–Alaska sinistral megashear (red line with red dotted extensions) with associated mid–late Jurassic pull-apart basins (yellow) and mélange (blue) simplified after [43].

The mid–late Jurassic age (169–148 Ma) of the Mexico–Alaska megashear is defined by the dates of sediment deposition in associated pull-apart basins and sedimentary mélange, as well as by dates of the preceding Siskiyou and the following Nevadan Orogenies. The structure is about 8000 km long, consisting of numerous faults of regional and local scale. It is generally NW-oriented transtensional, including the NE-trending transpressional segments in Alaska and the Blue Mountains, Oregon (Figure 6) and, smaller segments, in other areas [43]. The highly complex character of the megashear is evidence for its significant deformation by the later dextral motions, so that a primary orientation of the faults may not be confidently defined. Therefore, it may be inferred, that most of the local sinistral faults forming the megashear were initially NE trending, related to the accelerating Earth's rotation. Some of them have probably remained the primary NE orientation, but become transpressional, as reported in Alaska and Blue Mountains [43].

Wyld et al. [44] reconstructed the mid-Cretaceous (100 Ma) paleogeography of the United States and Canadian Cordillera, based on (a) restoring displacements within the major late Cretaceous to Cenozoic contractional and extensional belts, and (b) restoring displacements along the major Late Cretaceous to Cenozoic dextral strike-slip faults of the northern Cordillera. According to these reconstructions, the total mid-Cretaceous dextral displacements ranged from ~450 to 900 km.

Thus, the sinistral-to-dextral strike-slip transformation in the western North America took place from 125 to 100 Ma, the time immediately following CTGE (135–120 Ma) and is correlated with the similar event in East Asia (see Section 2.1 beforehand).

2.3. The CTGE-Related Paleotectonic Reconstructions for NE Asia and NW America

This section of our review is based on numerous geological materials compiled and summarised as the Phanerosoic tectonic paleoreconstructions by the international group of authors from U.S. Geological Survey, Exxon Exploration Co., Geological Survey of Canada, Michigan State University, Russian Academy of Sciences, University of Alaska, University of Texas, and Yakutian Academy of Sciences [6]. Figures 9–11 reproduce three of these reconstructions showing the tectonic evolution of North Pacific continental margins at 120–100 Ma, 100–84 Ma, and 84–52 Ma, respectively.

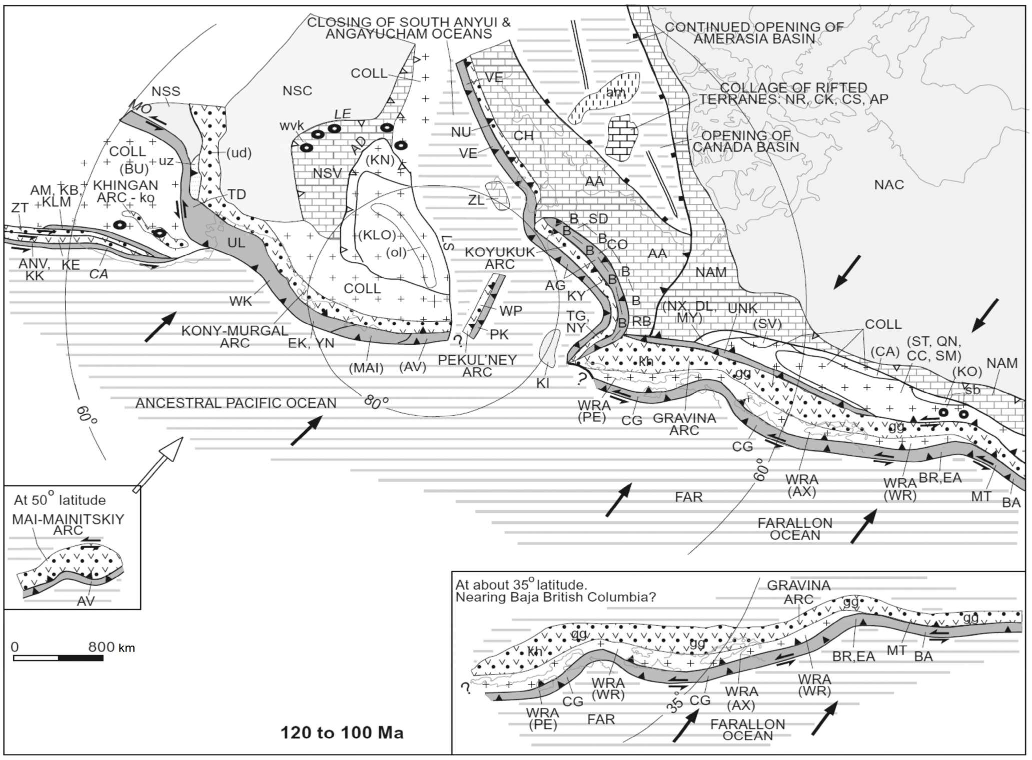

Figure 9. Aptian through Albian (120 to 100 Ma, at and after CTGE) stage of tectonic model by [6]. Larger black arrows indicate plate motions, while smaller black arrows indicate tectonic movements along strike slip faults. Other symbols are used to distinguish between different terranes that is insignificant for this study.

In these reconstructions, the sinistral-to-dextral transition is proposed to have occurred in the late Cretaceous time (84 Ma), that is 40–50 Ma after STGE. This is later than in the reconstruction by Wyld et al. [44], but also fits into the STGE hypothesis suggesting some delay between the cosmic event and its tectonic consequence on the Earth.

Other reconstructions by W. Nockleberg with coauthors, which are not reproduced in this work, traced the domination of sinistral displacements from early Cretaceous back to late Triassic (230–208 Ma) and the domination of dextral displacements from late Cretaceous forth to Quaternary (Figures 10–20 in [6]). This indicates a secular character of the considered strike-slip tectonics.

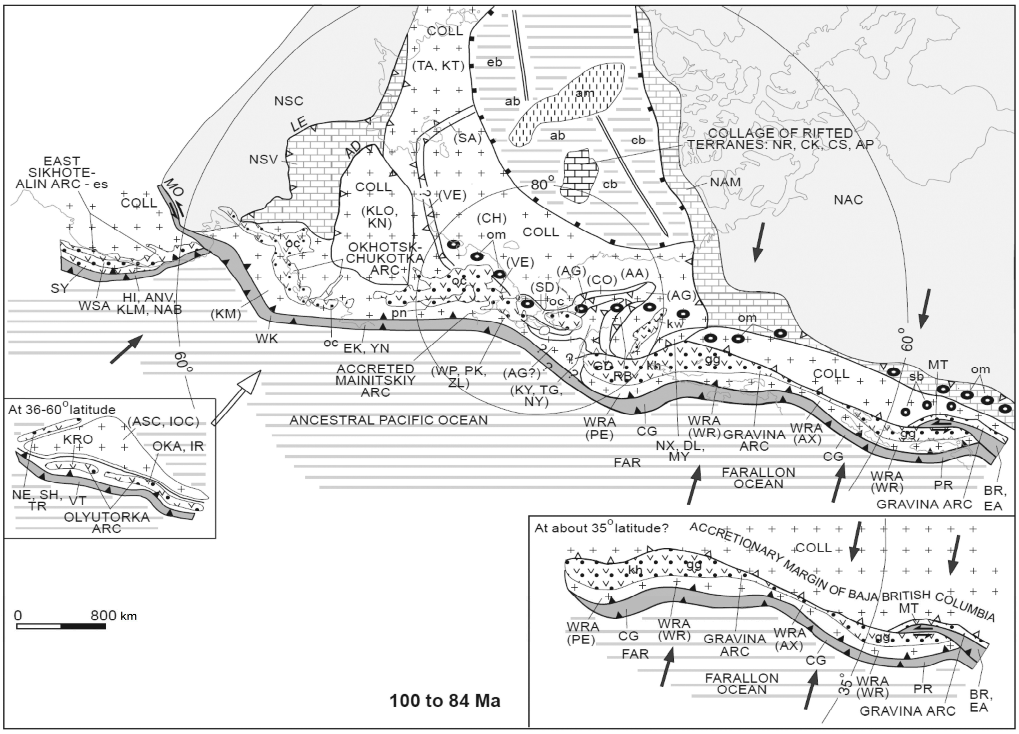

Figure 10. Cenomanian through Santonian (100–84 Ma, 20–30 Ma after STGE) stage of tectonic model by [6]. Larger black arrows indicate plate motions, while smaller black arrows indicate tectonic movements along strike slip faults. Other symbols are used to distinguish between different terranes that is insignificant for this study.

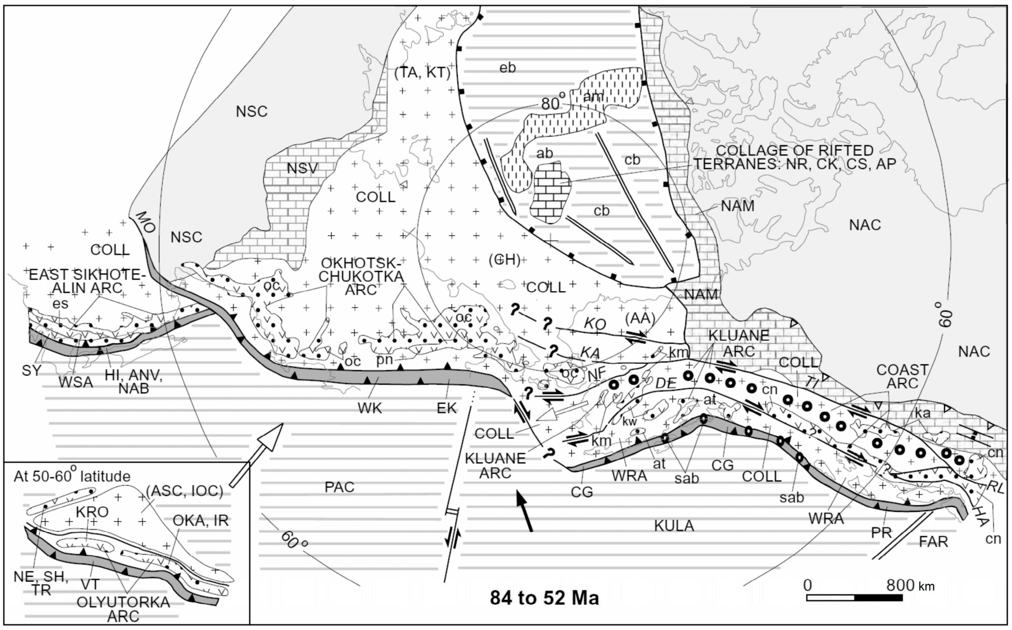

Figure 11. Campanian through early Eocene (84–52 Ma) stage of tectonic model by [6]. Larger black arrows indicate plate motions, while smaller black arrows indicate tectonic movements along strike slip faults. Other symbols are used to distinguish between different terranes that is insignificant for this study.

3. Discussion

All the tectonic paleo-reconstructions reviewed in the Results section beforehand support our suggestion that GTSE consisted not only in the significant transformation of various processes on and inside the Earth and the formation of giant ore and energetic resources [2,4,5], but also in a secular change of the Earth's rotation velocity. This change was reflected on both North Pacific continental margins by primary development of NE-sinistral shearing during the Mesozoic before CTGE and NW-dextral shearing after CTGE, including some lag between the cosmic and tectonic events. This may be considered as a direct contradiction to the Tretyak's assumption [3] that the galactic summer is accompanied by deceleration of the Earth's rotation and a correction of Utkin's suggestion [10] that the NE-sinistral displacements globally prevailed during the Mezo–Cenozoic time, while the NW-dextral movements dominated during Paleozoic. However, Utkin's general inference that the NE-sinistral shearing indicates acceleration of the Earth's rotation, while the NW-dextral shearing corresponds to its deceleration seems reasonable. Below, we will discuss possible causes of this inference with respect to the results of this review.

It should also be noted that the most popular explanation of the regional changes in strike-slip tectonics is that they are caused by changes in plate motions. Particularly, the Cenozoic dextral movements in East Asia are linked to the NNW-directed subduction of the Pacific to the Eurasian plates and the Indian–Eurasian collision [32,33]. There is no objection for this. However, the question is the following: what directs these plate movements? Could it partly be the decelerating Earth's rotation? Yes, just because the rotation is primary relative to plate tectonics, although the former may secondarily depend on the latter [45].

3.1. The Earth's Rotation and Distance from the Sun

Table 1 and Figure 12 demonstrate that the Earth occupies a very specific position in the solar system. Currently, it belongs to the group of planets, which are relatively distant from the Sun and rotating relatively fast, with the rotation period close to or shorter than the Earth's day. However, the Earth takes place near the boundary between the group with the distant and quickly rotating planets including Mars, Jupiter, Saturn and Neptune and another group including Venus and Mercury, which are orbiting closer to the Sun and rotate more slowly. In addition, Venus rotates in the opposite direction relative to all other planets of the Solar System.

Table 1. Distance from the Sun (in average) and rotation period of major planets in the solar system [46,47].

Planet	Distance from the Sun, mln. km	Rotation Period, Earth's Day
Mercury	57.9	58.67
Venus	108.2	243 [1]
Earth	149.6	1
Mars	227.9	1.03
Jupiter	778.6	0.41
Saturn	1433.5	0.44
Uranus	2872.5	0.72
Neptune	4495.1	0.67

[1] Retrograde rotation.

Following a general trend of the planets' rotation shown by the linking line in Figure 12, it may be inferred that the shorter distance from the Sun could cause the slower rotation of the Earth. On the other hand, the CTGE hypothesis suggests that the Earth was closer to the Sun during the Cretaceous than recently and during late Paleozoic [2]. Then, the Earth's rotation should decelerate before CTGE and accelerate after it. This totally contradicts the results of this review and corresponds to the widely accepted conception that rotation of Earth and other planets is primarily related to the causes from the initial stages of the solar system formation [12,13].

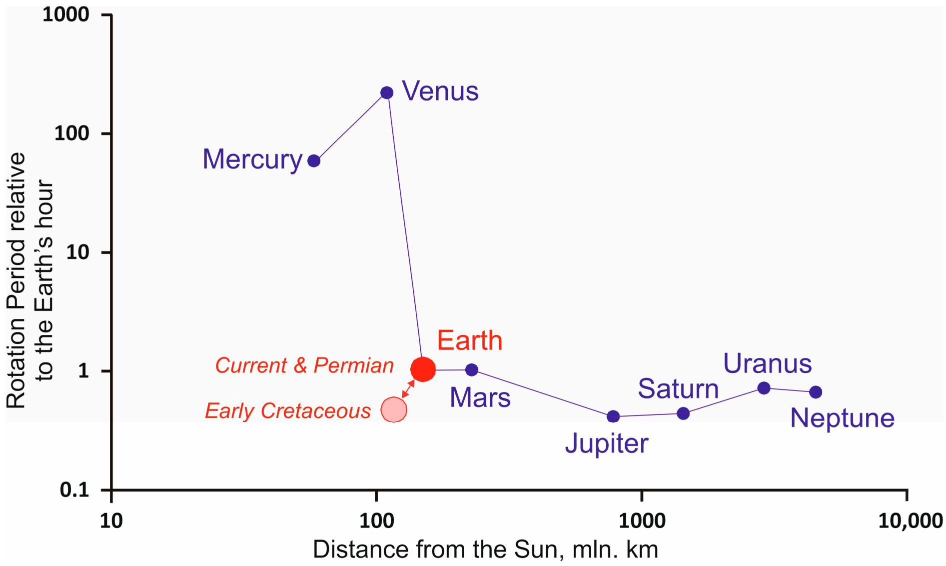

Figure 12. Distance from the Sun (in average) and rotation period of major planets in the solar system (based on data from [47]). The suggested position of the Earth at CTGE is shown not in scale.

3.2. The Earth's Rotation, Climate Change and Related Processes

As defined for the time after the last glaciation [12,13], melting of the continental ice sheets controls speed of the Earth's rotation. The increase of global temperature and associated melting of the ice caps lead to a decrease of the significant load on the Earth's crust, accompanied by the straightening and an uplift of the crust in the circumpolar regions. This geodynamic relaxation moves masses closer to the Earth's axis, which, according to the law of conservation of angular momentum, causes the Earth to rotate faster. The decrease of global temperature should have the opposite effect.

This corresponds well with the CTGE transformation of global climate and strike-slip tectonics on the North Pacific continental margins. The early–mid Cretaceous warming turned to cooling in the late Cretaceous and Cenozoic, a view that has been reported by several isotopic studies [2] (and references therein). This study has reviewed the tectonic paleo-reconstructions involved indicating the contemporary sinistral-to dextral transition of shearing that is suggested to be related to the change of accelerating to decelerating regimes of the Earth's rotation.

The correlation of the rotational, tectonic and climatic changes at CTGE can be additionally linked to the anomalously high magmatic activity and sea level [2,5]. This linkage was defined for the recent world by [45,48–51]. Other detailed studies have explored the particular nature, precise causes and debate related to Cretaceous anomalous magmatic [52,53], geothermal [54], slab super flux [55], oceanic spreading floor closure [56], high sea-stand [57] events, in geological processes spanning peak CTGE time.

The rotational effects of tidal friction, polar motions and other processes, which are considered in the literature [12,13,17], seem too low relative to the climatic change, so that we could not detect them in this study.

It may be noted finally that one of the most interesting questions raised by this review is the following: what was the relationship between the NE- and NW-trending strike-slip faults caused by CTGE? We suppose that it was very complex, including the rotation of tectonic blocks and the opening of local fractures filled with small magmatic intrusions and related ores [2,4].

4. Conclusions

The given review of Meso–Cenozoic strike-slip dislocations in the North Pacific realm may be summarized as follows:

1. Domination of sinistral shearing on the NE-oriented East Asian margin during the early Cretaceous, Jurassic and possibly Triassic times turned to significant development of dextral movements in the following mid–late Cretaceous and Cenozoic time.
2. Domination of dextral shearing on the NW-oriented Northwest American margin during late Cretaceous and Cenozoic followed significant development of sinistral movements in the preceding early–mid Cretaceous, Jurassic and possibly Triassic times.
3. In summary, these tectonic transformations indicate the change of the Earth' rotation from the accelerating to decelerating regime after CTGE (135–120 Ma).
4. The change of the Earth' rotation may be caused by the transition of the Earth' mass to, and consequently from, the polar regions, the processes related to melting and freezing of the ice caps corresponding to the increase and following decrease of global temperature.

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Data Availability Statement: Most of the data and figures supporting reported results can be found at the freely available publications referenced in Sections 2 and 3.

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References

1. Nechaev, V.P. On the galactic influence on the Earth during the last seven hundred million years. *Bull. Far East. Branch Russ. Acad. Sci.* **2004**, *2*, 102–112. (In Russian)
2. Nechaev, V.P.; Dai, S.; Sutherland, F.L.; Graham, I.T.; Nechaeva, E.V. The Cretaceous turn of geological evolution: Key evidence from East Asia. *Acta Geol. Sin.* **2018**, *92*, 1991–2003. [CrossRef]
3. Tretyak, A.N. The phenomenon of Galactic year in the Earth's evolution. *Geophys. J.* **1996**, *18*, 31–38. (In Russian)
4. Nechaev, V.P.; Sutherland, F.L.; Nechaeva, E.V. Metallogenic evolution of Northeast Asia related to the Cretaceous turn of geological evolution. *Minerals* **2022**, *12*, 400. [CrossRef]
5. Nechaev, V.P.; Sutherland, F.L.; Nechaeva, E.V. Phanerozoic evolution of continental large igneous provinces: Implications for galactic seasonality. *Minerals* **2022**, *12*, 1150. [CrossRef]
6. Nokleberg, W.J.; Parfenov, L.M.; Monger, J.W.H.; Norton, I.O.; Khanchuk, A.I.; Stone, D.B.; Scholl, D.W.; Fujita, K. Phanerozoic Tectonic Evolution of the Circum-North Pacific. *U.S. Geol. Surv. Prof. Pap.* **2001**, *1626*, 122. Available online: https://pubs.usgs.gov/pp/2000/1626/ (accessed on 6 March 2023).
7. Yakubchuk, A.S. Revised Mesozoic-Cenozoic orogenic architecture and gold metallogeny in the northern Circum-Pacific. *Ore Geol. Rev.* **2009**, *35*, 447–454. [CrossRef]
8. Voronov, P.S. *Essays on Regularities in the Morphology of the Earth's Global Relief*; Nauka: Leningrad, Russia, 1968. (In Russian)
9. Voronov, P.S. Two problems of planetary geology. *J. Min. Inst.* **1979**, *81*, 61–68. Available online: https://pmi.spmi.ru/index.php/pmi/article/view/11044 (accessed on 6 March 2023). (In Russian)
10. Utkin, V.P. *Strike-Slip Dislocations and Methods for Their Study*; Nauka: Moscow, Russia, 1980; p. 144. (In Russian)
11. Utkin, V.P. Rotation nature of tectogenesis of continental margins and breakdown of the Laurasian and Gondwanan supercontinents. *Dokl. Earth Sci.* **2007**, *416*, 1000–1003. [CrossRef]
12. Mikanovsky, E.E. (Ed.) . *Rotational Processes in Geology and Physics*; KomKniga: Moscow, Russia, 2007; p. 528. (In Russian)
13. McCarthy, D.D.; Seidelmann, P.K. *TIME—From Earth Rotation to Atomic Physics*; Wiley-VCH: Weinheim, Germany, 2009; p. 351. [CrossRef]
14. Newcomb, S. *Side-Lights on Astronomy and Kindred Fields of Popular Science. Essays and Addresses*; Harper & Brothers: London, UK; Harper & Brothers: New York, NY, USA, 1906; p. 349. Available online: https://www.gutenberg.org/cache/epub/4065/pg4065--images.html (accessed on 6 February 2023).

15. Stovas, M.V. Some questions of tectogenesis. In *Problems of Planetary Geology*; GosGeolTechIzdat: Moscow, Russia, 1963; pp. 222–274. (In Russian)
16. Pavlov, N.N. Change of the Earth's rotation velocity, deformation of the Earth's crust and the solar activity. *Proc. Cent. Astron. Obs. Russ. Acad. Sci. Pulkovo* **1968**, *183*, 3–23. (In Russian)
17. Crossley, D.J. Core undertones with rotation. *Geophys. J. Int.* **1975**, *42*, 477–488. [CrossRef]
18. Ivanov, B.A. *Central Sikhote-Alin Fault*; Far East Book House: Vladivostok, Russia, 1972; p. 114. (In Russian)
19. Xu, J.; Zhu, G.; Tong, W.; Cui, K.; Liu, Q. Formation and evolution of the Tancheng-Lujiang wrench fault system: A major shear system to the northwest of the Pacific Ocean. *Tectonophysics* **1987**, *134*, 273–310. [CrossRef]
20. Xu, J. *The Tancheng-Lujiang Wrench Fault System*; John Wiley & Sons: Chichester, UK, 1993; p. 279.
21. Utkin, V.P. Tan-Lu and Sikhote-Alin transregional structural paragenesis and its role in continental riftogenesis. *Dokl. Earth Sci.* **2012**, *444*, 687–691. [CrossRef]
22. Yang, F.; Hu, P.; Zhou, X.; Zhang, R.; Peng, Y.; Li, X.; Qiu, D. The Late Jurassic to Early Cretaceous strike-slip faults in the Subei-South Yellow Sea Basin, eastern China: Constraints from seismic data. *Tectonics* **2020**, *39*, e2020TC006091. [CrossRef]
23. Khanchuk, A.I.; Golozoubov, V.V.; Simanenko, V.P.; Malinovskii, A.I. Giant folds with steeply dipping hinges in structures of orogenic belts: Evidence from Sikhote Alin. *Dokl. Earth Sci.* **2004**, *395*, 165–169.
24. Khanchuk, A.I.; Kemkin, I.V.; Kruk, N.N. The Sikhote-Alin orogenic belt, Russian South East: Terranes and the formation of continental lithosphere based on geological and isotopic data. *J. Asian Earth Sci.* **2016**, *120*, 117–138. [CrossRef]
25. Zhang, Y.Q.; Dong, S.W. Mesozoic tectonic evolution history of the Tan-Lu fault zone, China: Advances and new understanding. *Geol. Bull. China* **2008**, *27*, 1371–1390.
26. Sokolov, S.D.; Tuchkova, M.I.; Ganelin, A.V.; Bondarenko, G.E.; Layer, P. Tectonics of the South Anyui Suture, Northeastern Asia. *Geotectonics* **2015**, *49*, 3–26. [CrossRef]
27. Allen, M.B.; Macdonald, D.I.M.; Xun, Z.; Vincent, S.J.; Brouet-Menzies, C. Early Cenozoic two-phase extension and late Cenozoic thermal subsidence and inversion of the Bohai Basin, northern China. *Mar. Pet. Geol.* **1997**, *14*, 951–972. [CrossRef]
28. Wang, R.; Shi, W.Z.; Xie, X.Y.; Zhang, X.P.; Wang, L.L.; Walter, M.; Arthur, B.B. Coupling of strike-slip faulting and lacustrine basin evolution: Sequence stratigraphy, structure, and sedimentation in the North Yellow Sea Basin (West Bay basin offshore North Korea), eastern China. *Mar. Pet. Geol.* **2020**, *120*, 104548. [CrossRef]
29. Jolivet, L.; Fournier, M.; Huchon, P.; Rozhdestvensky, V.S.; Sergeyev, K.F.; Oscorbin, L. Cenozoic intracontinental dextral motion in the Okhotsk-Japan Sea region. *Tectonics* **1992**, *11*, 968–977. [CrossRef]
30. Jolivet, L.; Maluski, H.; Beyssac, O.; Goffé, B.; Lepvrier, C.; Thi, P.T.; Vuong, N.V. Oligocene-Miocene Bu Khang extensional gneiss dome in Vietnam: Geodynamic implications. *Geology* **1999**, *27*, 67–70. [CrossRef]
31. Peirce, J.W. The northward motion of India since the Late Cretaceous. *Geophys. J. Int.* **1978**, *52*, 277–311. [CrossRef]
32. Huang, L.; Liu, C.; Xu, C.; Wu, K.; Wang, G.; Jia, N. New insights into the distribution and evolution of the Cenozoic Tan-Lu Fault Zone in the Liaohe sub-basin of the Bohai Bay Basin, eastern China. *Tectonophysics* **2017**, *722*, 373–382. [CrossRef]
33. Wang, G.; Li, S.; Wu, Z.; Suo, Y.; Guo, L.; Wang, P. Early Paleogene strike-slip transition of the Tan–Lu Fault Zone across the southeast Bohai Bay Basin: Constraints from fault characteristics in its adjacent basins. *Geol. J.* **2019**, *54*, 835–849. [CrossRef]
34. Kasatkin, S.A.; Grebennikov, A.V. The early Paleogene strike-slip tectonic setting along the northeastern Asian margin: Structural control on magmatism. *Int. Geol. Rev.* **2022**. [CrossRef]
35. Nelson, J.; Colpron, M. Tectonics and metallogeny of the British Columbia, Yukon and Alaskan Cordillera, 1.8 Ga to the present. In *Mineral Deposits of Canada: A Synthesis of Major Deposit-Types, District Metallogeny, the Evolution of Geological Provinces, and Exploration Methods*; Goodfellow, W.D., Ed.; Special Publication; Geological Association of Canada, Mineral Deposits Division: St. John's, NL, Canada, 2007; Volume 5, pp. 755–791.
36. Vanderhaeghe, O.; Burg, J.-P.; Teyssier, C. Canadian Cordillera and French Variscides. *Geol. Soc. Lond. Spec. Publ.* **1999**, *154*, 181–204. [CrossRef]
37. Gabrielse, H.; Murphy, D.C.; Mortensen, J.K. Cretaceous and Cenozoic dextral orogen-parallel displacements, magmatism and paleogeography, north-central Canadian Cordillera. In *Paleogeography of the North American Cordillera: Evidence for and against Large-Scale Displacements*; Haggart, J.W., Monger, J.W.H., Enkin, R.J., Eds.; Special Paper; Geological Association of Canada: St. John's, NL, Canada, 2006; Volume 46, pp. 255–276.
38. Monger, J.W.H.; van der Heyden, P.; Journeay, J.M.; Evenchick, C.A.; Mahoney, J.B. Jurassic-Cretaceous basins along the Canadian Coast Belt: Their bearing on pre-mid-Cretaceous sinistral displacements. *Geology* **1994**, *22*, 175–178. [CrossRef]
39. Umhoefer, P. A model for the North America Cordillera in the Early Cretaceous: Tectonic escape related to arc collision of the Guerrero terrane and a change in North America plate motion. In *Tectonic Evolution of Northwestern Mexico and the Southwestern USA*; Special Paper; Geological Society of America: Boulder, CO, USA, 2003; Volume 374, pp. 117–134. [CrossRef]
40. Nelson, J.L.; Colpron, M.; Israel, S. The Cordillera of British Columbia, Yukon, and Alaska: Tectonics and metallogeny. In *Tectonics, Metallogeny, and Discovery: The North American Cordillera and Similar Accretionary Settings*; Colpron, M., Bissig, T., Rusk, B.G., Thompson, J.F.H., Eds.; Society of Economic Geologists: Denver, CO, USA, 2013; Volume 17, pp. 59–109. [CrossRef]
41. Sauer, K.B.; Gordon, S.M.; Miller, R.B.; Vervoort, J.D.; Fisher, C.M. Evolution of the Jura-Cretaceous North American Cordilleran margin: Insights from detrital-zircon U-Pb and Hf isotopes of sedimentary units of the North Cascades Range, Washington. *Geosphere* **2017**, *13*, 2094–2118. [CrossRef]

42. Beranek, L.P.; McClelland, W.C.; van Staal, C.R.; Israel, S.; Gordee, S.M. Late Jurassic flare-up of the Coast Mountains arc system, NW Canada, and dynamic linkages across the northern Cordilleran orogen. *Tectonics* **2017**, *36*, 877–901. [CrossRef]
43. Anderson, T.H. Jurassic (170–150 Ma) basins: The tracks of a continental-scale fault, the Mexico-Alaska megashear, from the Gulf of Mexico to Alaska. In *Late Jurassic Margin of Laurasia—A Record of Faulting Accommodating Plate Rotation*; Anderson, T.H., Didenko, A.N., Johnson, C.L., Khanchuk, A.I., MacDonald, J.H., Jr., Eds.; Special Paper; Geological Society of America: Boulder, CO, USA, 2015; Volume 513, pp. 107–188. [CrossRef]
44. Wyld, S.J.; Umhoefer, P.J.; Wright, J.E. Reconstructing northern Cordilleran terranes along known Cretaceous and Cenozoic strike-slip faults: Implications for the Baja British Columbia hypothesis and other models. In *Paleogeography of the North American Cordillera: Evidence for and Against Large-Scale Displacements*; Haggart, J.W., Enkin, R.J., Monger, J.W.H., Eds.; Special Paper; Geological Association of Canada: Newfoundland and Labrador, NL, Canada, 2006; Volume 46, pp. 277–298.
45. Riguzzi, F.; Panza, G.; Varga, P.; Doglioni, C. Can Earth's rotation and tidal despinning drive plate tectonics? *Tectonophysics* **2010**, *484*, 60–73. [CrossRef]
46. Weissman, P.R. The Solar System and Its Place in the Galaxy. In *Encyclopedia of the Solar System*, 3rd ed.; Spohn, T., Breuer, D., Johnson, T., Eds.; Elsevier: Amsterdam, The Netherlands, 2014; pp. 3–28.
47. Dehant., V.; Van Hoolst, D. Rotation of planets. In *Encyclopedia of the Solar System*, 3rd ed.; Spohn, T., Breuer, D., Johnson, T., Eds.; Elsevier: Amsterdam, The Netherlands, 2014; pp. 159–184.
48. Palladino, D.M.; Sottili, G. Earth's spin and volcanic eruptions: Evidence for mutual cause-and-effect interactions? *Terra Nova* **2013**, *26*, 78–84. [CrossRef]
49. Sottili, G.; Palladino, D.M.; Cuffaro, M.; Doglioni, C. Earth's rotation variability triggers explosive eruptions in subduction zones. *Earth Planets Space* **2015**, *67*, 208. [CrossRef]
50. Sottili, G.; Lambert, S.; Palladino, D.M. Tides and Volcanoes: A Historical Perspective. *Front. Earth Sci.* **2021**, *9*, 777548. [CrossRef]
51. Dumont, S.; Petrosino, S.; Neves, M.C. On the link between global volcanic activity and global mean sea level. *Front. Earth Sci.* **2022**, *10*, 845511. [CrossRef]
52. Fletcher, M.; Wyman, P.A.; Zahirovic, S. Mantle plumes, triple junctions and transforms: A reinterpretation of Pacific Cretaceous–Tertiary LIPS and the Laramide connection. *Front. Geosci.* **2020**, *11*, 1133–1144. [CrossRef]
53. Rodriguez, M.; Arnould, M.; Coltice, N.; Soret, M. Long-term evolution of a plume-induced subduction in the Neotethys realm. *Earth Planet. Sci. Lett.* **2021**, *561*, 116798. [CrossRef]
54. Holtmann, R.; Muňoz- Montecinos, J.; Angiboust, S.; Cambeses, A.; Bonnet, G.; Brown, A.; Dragovic, B.; Gharamohammadi, Z.; Rodriguez, M.; Glodny, J.; et al. Cretaceous thermal evolution of the closing Neo-Tethyan realm revealed by multimethod petrochronology. *Lithos* **2021**, *422–423*, 106731. [CrossRef]
55. East, M.; Müller, R.D.; Williams, S.; Zahirovic, S.; Heine, C. Subduction history, Cretaceous slab, superflux, as a possible cause for the mid-Cretaceous plume pulse and superswell events. *Gondwana Res.* **2020**, *79*, 125–139. [CrossRef]
56. Seton, M.; Gaina, C.; Müller, R.D.; Heine, C. Mid-Cretaceous seafloor spreading pulse. Fact or Fiction? *Geology* **2009**, *37*, 687–690. [CrossRef]
57. Ray, D.C.; van Buchem, F.S.P.; Baines, G.; Greséllе, B.; Simmons, M.D.; Robson, C. The magnitude and cause of short-term Cretaceous sea-level change—A synthesis. *Earth Sci. Rev.* **2019**, *197*, 102901. [CrossRef]