



University
of Regina



ISCMRDET 2026

Proceedings

International Symposium on
Sustainable **Critical Mineral Resource** Development
for **Energy Transition**

Proceedings International Symposium on
Sustainable Critical Mineral Resource Development for Energy Transition



Themes

1. Critical mineral resources and their significance for energy transition
2. Geology and potential of critical mineral resources
3. Sustainable mining, processing, recovery of critical minerals



TRANSPORT PUBLISHING HOUSE



ISBN: 978-604-76-3351-7



9 786047 633517

SÁCH KHÔNG BÁN

THE INTERNATIONAL SYMPOSIUM
Sustainable Critical Mineral Resource
Development for Energy Transition
(ISCMRDET 2026)

ORGANIZING COMMITTEE

1. Prof. Dr. Tran Thanh Hai	Head of the Committee Rector of the Hanoi Uni. of Mining and Geology
2. Prof. Phillip Choi	University of Regina, Canada
3. Prof. Raman Paranjape	University of Regina, Canada
4. Assoc. Prof. Do Ngoc Anh	Hanoi Uni. of Mining and Geology
5. Assoc. Prof. Nguyen Thi Hoai Nga	Hanoi Uni. of Mining and Geology
6. Dr. To Xuan Ban	Hanoi Uni. of Mining and Geology
7. Assoc. Prof. Pham Van Hoa	Hanoi Uni. of Mining and Geology
8. Assoc. Prof. Ngo Xuan Thanh	Hanoi Uni. of Mining and Geology
9. Dr. Bui Vinh Hau	Hanoi Uni. of Mining and Geology
10. Dr. Ngo Thi Kim Chi	Hanoi Uni. of Mining and Geology
11. Assoc. Prof. Nguyen Anh Tuan	Hanoi Uni. of Mining and Geology
12. Assoc. Prof. Pham Van Luan	Hanoi Uni. of Mining and Geology

Table of Contents

The Ngoc Linh Complex in Central Kon Tum Massif: an exposed remnant of the Early Paleozoic collisional tectonism in East Central Indochina mainland

Hai Thanh Tran, Truong Tai Nguyen, Hau Vinh Bui, Thanh Xuan Ngo, Monsup Cho, Chi Kim Ngo, Dao Anh Vu, Hiep Huu Nguyen, Binh Van Phan, Hung Quoc Nguyen..... 1

Late Cretaceous Magmatism in the Nui Sam Area (An Giang Province, Southwestern Vietnam): Implications for the Tectono-Magmatic Evolution of the Ankroet Complex

Bui Vinh Hau, Tran Thanh Hai, Nguyen Truong Tai, Ngo Thi Kim Chi, Phan Van Binh, Vu Anh Dao, Nguyen Huu Hiep, Nguyen Quoc Hung, Ngo Xuan Thanh 10

U–Pb zircon geochronology of meta-diorite in the Vit Thu Lu area, northern Quang Tri, central Vietnam

Dinh Trong Tuong, Nguyen Quoc Hung, Tran My Dung, Ha Tri Dung, Dang My Cung, Ngo Xuan Thanh 16

Post-collisional extension during the Early Paleozoic in Northeast Vietnam: Evidence from syenitic complex

Chu Van Dung, Tran My Dung, Ngo Xuan Thanh 23

Zircon U–Pb constraints on episodic magmatism of the Hai Van granitoid complex and implications for the Indosinian orogeny in central Vietnam

Dinh Trong Tuong, Ngo Xuan Thanh, Tran My Dung Ha Tri Dung 34

Controlling factors on mineralization in the Tram Tau felsic volcanic formation (Tu Le Basin, North Vietnam)

Tran Thi Huong, Nguyen Hoang, Tran Thanh Hai 42

Distribution and Metamorphic Evolution of REE-bearing Minerals in Metapelitic Rocks of the Nam Co Formation, Song Ma Suture Zone, NW Vietnam

Bui Vinh Hau 56

Technology for rare earth ore beneficiation in Vietnam

Thanh Hai Pham..... 63

Structural and tectonic controls on gold mineralization in the northern Kon Tum massif, Vietnam

Vu Tien Thanh, Nguyen Van Vuong, Luong Thi Thu Hoai 73

Potential for Marine Ion-Adsorption Rare Earth Deposits: Sedimentary Facies Controls in Southwestern Vietnam

Nguyen Huu Hiep, Phan Van Binh, Tran Thanh Hai, Bui Hoang Bac 85

Fluvial geomorphology and weathering crust controls on ion-adsorption rare earth element mineralization in Northwestern Vietnam

Dinh Thi Hue, Vu Anh Dao 93

Tectonic – Geomorphology and its relation to geo-hazards in the Southwest region of Vietnam

Nguyen Xuan Nam, Tran Thanh Hai, Ngo Thi Kim Chi, Hoang Ngo Tu Do, Vu Anh Dao, Nguyen Xuan Quang..... 100

Grain-size and mineralogical characteristics of surface sediments in the Con Co Island area and their environmental significance

<i>Phan Van Binh, Hoang Van Long, Le Anh Thang, Vu Anh Dao, Nguyen Huu Hiep, Nguyen Quoc Hung, Bui Vinh Hau, Vo Thi Cong Chinh, Nguyen Thi My Hanh</i>	108
Shoreline change assessment on Phu Quoc Island using Satellite Remote Sensing and the Digital Shoreline Analysis System (DSAS)	
<i>Ngo Thi Kim Chi, Tran Thanh Hai, Bui Minh Quan, Bui Vinh Hau, Phan Van Binh, Vu Anh Da¹, Nguyen Xuan Quang</i>	117
Geological characteristics of karst and their relationship to underground karst collapse in Quang Ninh province	
<i>Nguyen Xuan Nam, Nguyen Dinh Tuan, Doan Thi Ngoc Huyen</i>	124
Retaining Structures Using Gabion System: Case Examples to be Applied Further in Mining Engineering Projects	
<i>Phan Van Binh, Vu Anh Dao, Bui Vinh Hau, Nguyen Xuan Nam, Vo Thi Cong Chinh, Nguyen Thi Minh Thu</i>	138
Geological hazards at the main dam of Dap Troi reservoir, Ninh Binh Province, Vietnam	
<i>Ban To Xuan</i>	150
The erosion and accretion at Day River mouth, Vietnam	
<i>Ban To Xuan</i>	161
Spatio-temporal variation of agricultural drought based on SMAPI evaluation toward supporting water resources management in the Red River Basin	
<i>Nguyen Hoang Hiep, Nguyen Lan Huong, Tran Thi Phuong Linh</i> , ...	179
Landslide hotspot identification by instance-based learning: A comparison of k-nearest neighbour and the entropy-based distance algorithm (Kstar)	
<i>Minh Nhut Dao, Quoc Phi Nguyen, Duong Van Hoa</i>	188
Performance of stochastic inversion approaches of groundwater flow and heat transport modeling in parameter estimation	
<i>Doan Thi Thanh Thuy, Nguyen Hoang Hiep, Nguyen Bach Thao, Vu Thu Hien</i>	203
Environmental Issues of Rare Earth and Critical Mineral Mining in Vietnam	
<i>Quoc Phi Nguyen, Thi Mai Hoa Phan, Thi Cuc Nguyen, Quang Minh Nguyen, Van Binh Nguyen, Trung Thanh Dao, Minh Nhut Dao, Ha Tuan Anh, Khanh Phuong Mai</i>	210
Application of the remote sensing ecological index (RSEI) to assess ecological quality in Coal mining areas of Quang Ninh province, Viet Nam	
<i>Nguyen Thi Cuc, Phan Thi Mai Hoa, Nguyen Anh Hoa, Nguyen Van Bin</i>	219
Environmental vulnerability assessment for sustainable mining using GIS based AHP - VIKOR approach: A Case Study of Ha Quang, Cao Bang District, Vietnam	
<i>Phan Thi Mai Hoa, Nguyen Quoc Phi, Nguyen Thi Cuc</i>	230
Assessment of Hydrodynamic Changes Induced by Dredging and Sand Mining in Tra Ly Estuary for Sustainable Resource Management	
<i>Vu Thi Lan Anh, Nguyen Thi Hoa, Nguyen Thi Hong, Tran Thi Ngoc, Vu Van Ngoc, Nguyen Cham Anh, Nguyen Thi Thuy Hien, Phan Thi Mai Hoa</i>	246

The Ngoc Linh Complex in Central Kon Tum Massif: an exposed remnant of the Early Paleozoic collisional tectonism in East Central Indochina mainland

Hai Thanh Tran^{1,2*}, Truong Tai Nguyen^{1,2,3}, Hau Vinh Bui^{1,2}, Thanh Xuan Ngo^{1,2}, Moon-sup Cho⁴, Chi Kim Thi Ngo^{1,2}, Dao Anh Vu^{1,2}, Hiep Huu Nguyen^{1,2}, Binh Van Phan^{1,2}, Hung Quoc Nguyen^{1,2}

¹ Department of Geology, Hanoi University of Mining and Geology, Hanoi, Vietnam

² Key research group "Tectonics and Geodynamics for Geo-resources, Environment and Sustainable Development", Hanoi University of Mining and Geology.

³ Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan (R.O.C);

⁴ Chung Book National University, Chung Book, Republic of Korea

***Corresponding author:** Hai Thanh Tran (tranthanhhai@hmg.edu.vn)

ABSTRACT

The Ngoc Linh Complex forms the amphibolite- to migmatite-grade core of the central Kon Tum Massif and is one of the most intensely deformed crustal domains exposed in central Vietnam. The complex is bounded by the high-grade Kan Nack Complex to the east and by the Kham Duc–A Vuong assemblages to the west. Field relationships documented in the original manuscript show that the Ngoc Linh Complex is not a coherent stratigraphic unit, but a tectonically dismembered package of gneiss, amphibolite, marble, schist, migmatite and mafic–ultramafic bodies enclosed within regional high-strain zones. Five deformational events (D1–D5) can be distinguished. D1 is the dominant event and produced the penetrative schistosity (S1), mélanges, mylonitic thrust zones, and isoclinal to sheath folds, indicating strong collisional shortening and tectonic stacking. D2 refolded and sheared the D1 architecture, generating the regional northwest–southeast structural grain that characterizes the massif today. D3–D5 are progressively more localized brittle to brittle–ductile events that modified earlier fabrics without fundamentally changing the first-order architecture. The structural pattern, together with regional geochronological constraints from previous studies, supports interpretation of the Ngoc Linh Complex as an exposed remnant of an Early Paleozoic collisional system later reworked during Permian–Triassic tectonothermal events.

Keywords: *Ngoc Linh Complex; Kon Tum Massif; collisional tectonism; ductile deformation; Early Paleozoic; Indochina Block*

1. Introduction

The Kon Tum Massif of Central Vietnam has traditionally been regarded as the 'core' of the Indochina Block (Figure 1). This crustal entity is exposed as a highly metamorphosed terrane previously interpreted as Archean to Proterozoic in age. Regional studies from the early 20th century to the present (Fromaget, 1939, 1941; Tran Van Tri, 1979; Nguyen Xuan Tung and Tran Van Tri, 1982; Tran Duc Luong and Nguyen Xuan Bao, 1982; Nguyen Xuan Bao, 2000; Tong Duy Thanh and Vu Khuc, 2005; Tran Van Tri and Vu Khuc, 2009) characterize it as an ancient metamorphic core complex reactivated by Phanerozoic magmatic and tectonic events. Lithologically, the Kon Tum Massif comprises several tectonostratigraphic assemblages ranging from supposedly Archean to Cenozoic in age, all variably and multiply deformed

through a protracted thermotectonic history (Tran Ngoc Nam et al., 2001; Osanai et al., 2003; Usuki et al., 2009; Lepvrier et al., 2004, 2008; Nakano et al., 2013; Tran et al., 2014; Faure et al., 2018).

The eastern portion of the study area is dominated by the Kan Nak Complex, which comprises dominantly granulite-facies rocks including two-pyroxene mafic granulite, gneiss, garnet-cordierite-hypersthene pelitic granulite, and calciphyte (Tran Van Tri and Vu Khuc, 2009). Metamorphic conditions have been estimated at 800–1000°C and 8–11 kbar (Tran Ngoc Nam et al., 2004; Vu Van Tich, 2005). The age of the Kan Nak Complex remains debated, with

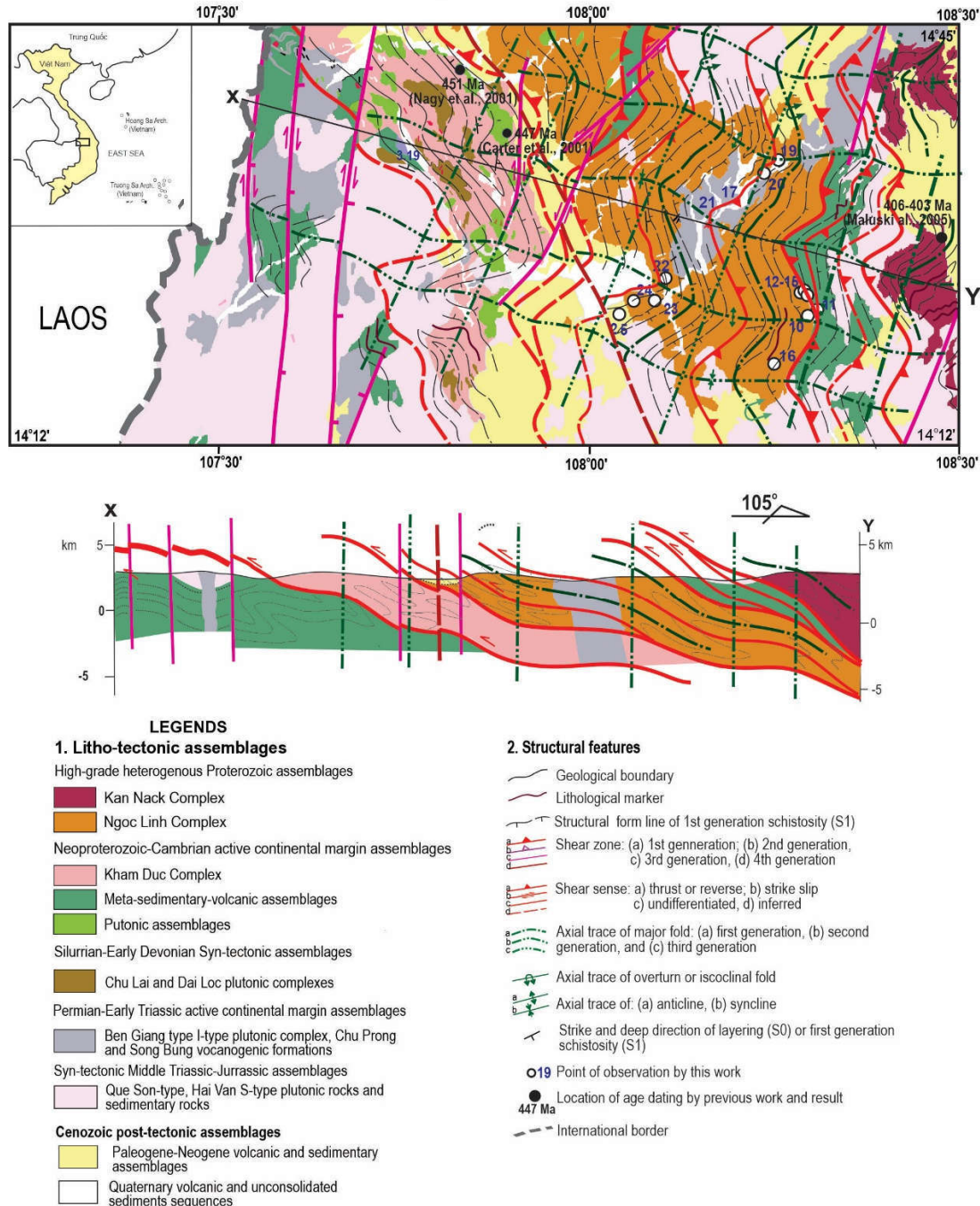


Figure 1. Geological structure of the study area

estimates ranging from Archean to Paleoproterozoic for the protolith and multiple metamorphic overprints in the Ordovician and Late Permian–Early Triassic (Nakano et al., 2013; Tran et al., 2014; Tri et al., 2020).

The central part of the study area is dominated by the Ngoc Linh Complex, which consists primarily of highly metamorphosed and dismembered gneisses, crystalline schists, amphibole gneiss, biotite gneiss, amphibolite, marble, and migmatite (Tran Van Tri and Vu Khuc, 2009). Isotopic ages range from 2541 to 1455 Ma (U-Pb age of relict zircon cores; Tran Ngoc Nam et al., 1998, 2001) with Nd-Sm Tb^M model ages of 2400–1200 Ma (Lan et al., 2003), suggesting a Paleoproterozoic to Neoproterozoic protolith age. The western portion of the study area comprises the Kham Duc–Nui Vu Complex (medium-P garnet-kyanite-sillimanite schist and gneiss; Usuki et al., 2004, 2009; Nakano et al., 2007) and the weakly metamorphosed Early Paleozoic A Vuong Formation (Nguyen Van Trang, 1986). Van Long, 2009b).

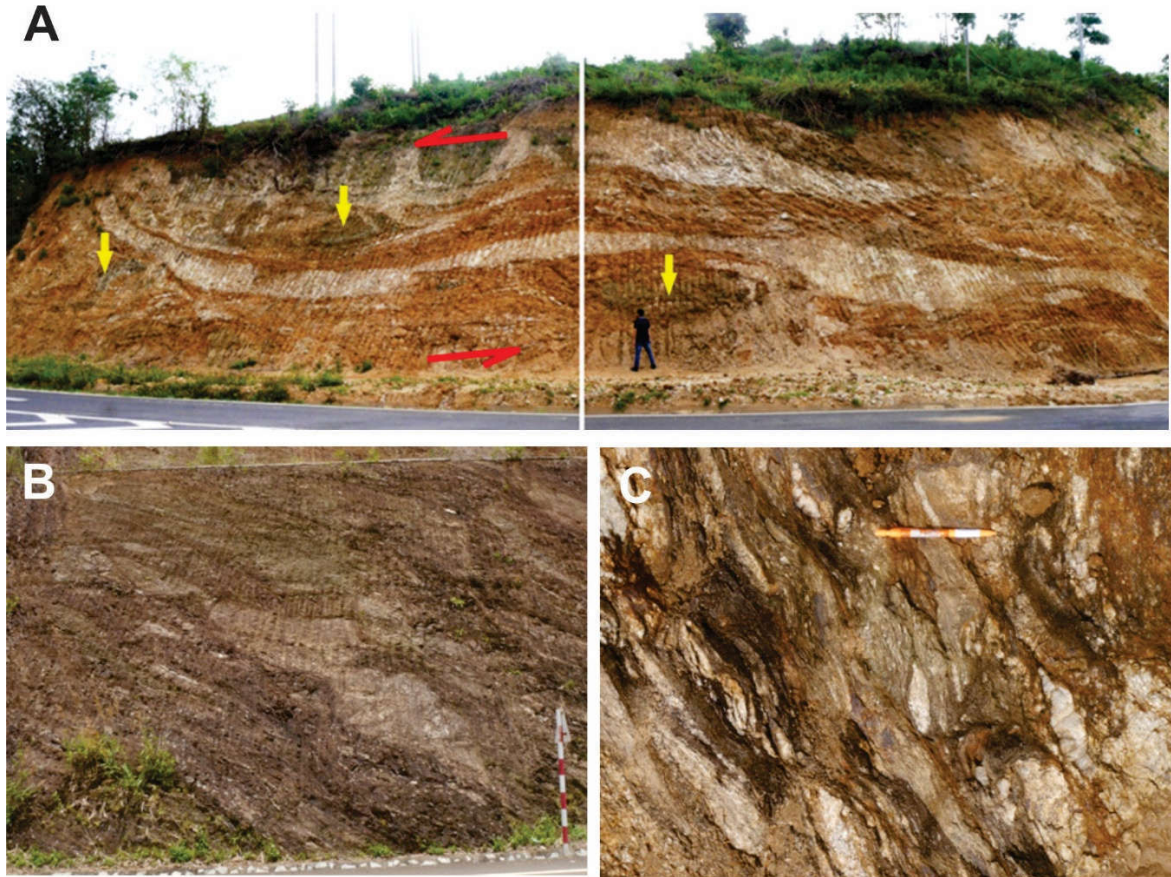


Figure 2. Represented lithotectonic assemblages comprising the Ngoc Linh Complex in central Kon Tum area. A. A thick nappe-style ductile shearing thrust zone with numerous boudinages, mélangé-style bodies of metagabbro (yellow arrows) and pegmatite (light coloured) seen in Kon Rẫy, Kon Tum. Note some mafic boudins constant pre-existing foliation or dikes, which wrapped around by mylonitic fabrics of the shear zone B. part of Ngoc Linh Complex comprising of numerous highly deformed boudins of different rock types bounded by high-strain zone, forming a mélangé zone. C. Close-up view of part of Ngoc Linh Complex showing strongly deformed and dismembered shear structures.

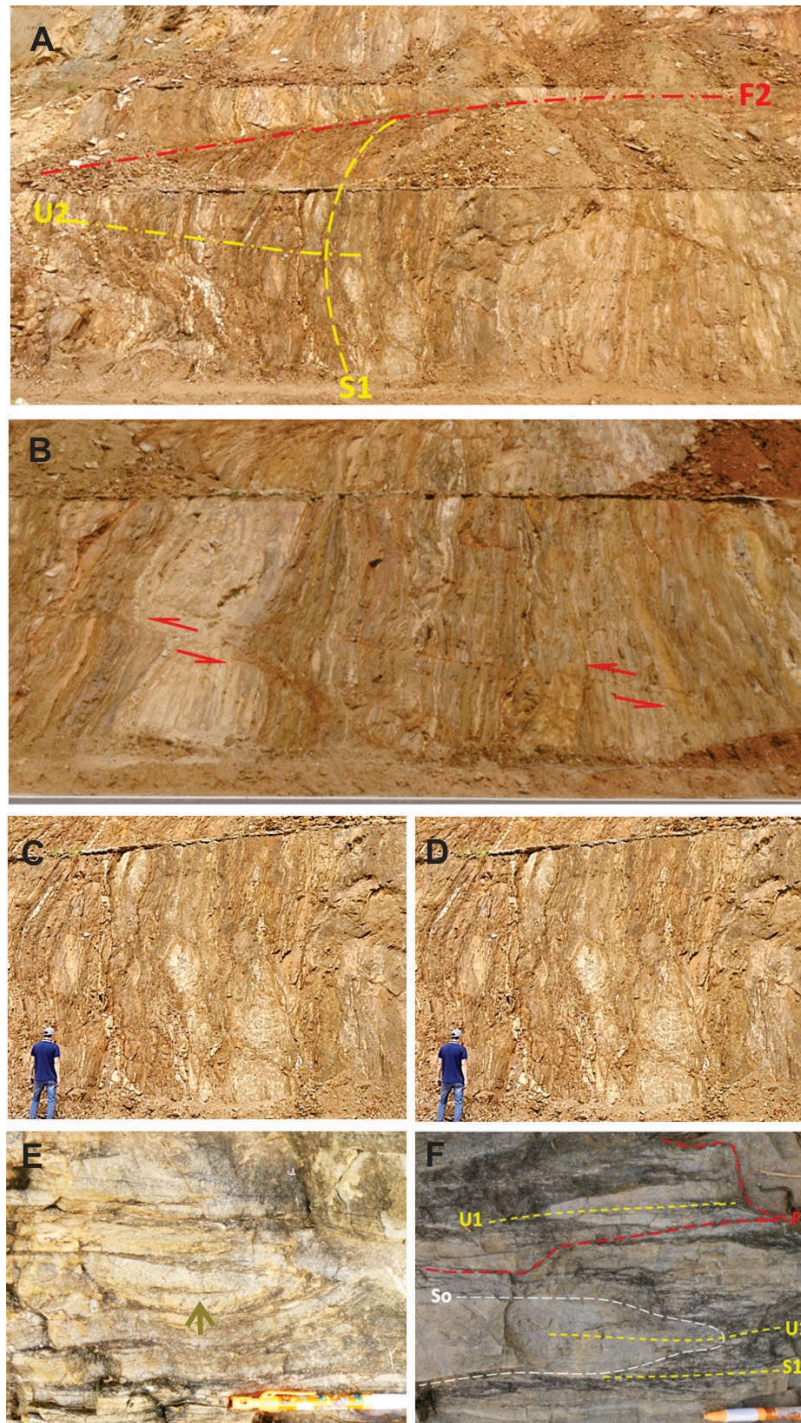


Figure 3. A: Part of a thick high strain zone defined by thorough dismembered and shear rocks, formed during first generation deformation (D1), which reformed by second generation structures (D2) including northwest trending inclined fold (U2) and shear (F2) seen along a road-cut, Kon Rãy area (view look northeast). B: Strongly sheared and boudinage heterogeneous lithologic assemblage caused by first deformation phase that cross-cut by second generation thrust shear (red arrows). C and D: Close-up view of part of Ngoc Linh Complex showing strongly sheared, mélangé-style rocks with various composition that formed during D1. E: sheath folds (arrow) lying parallel to the first generation schistosity (S1) in Ngoc Linh Complex indicating tectonic transportation during D1 deformation. F: A system of first generation isoclinal recumbent folds (U1) with strong axial planes forming first generation schistosity (S1). The structures observed indicate typical regional fold-thrust style, high-strain deformation related to collision

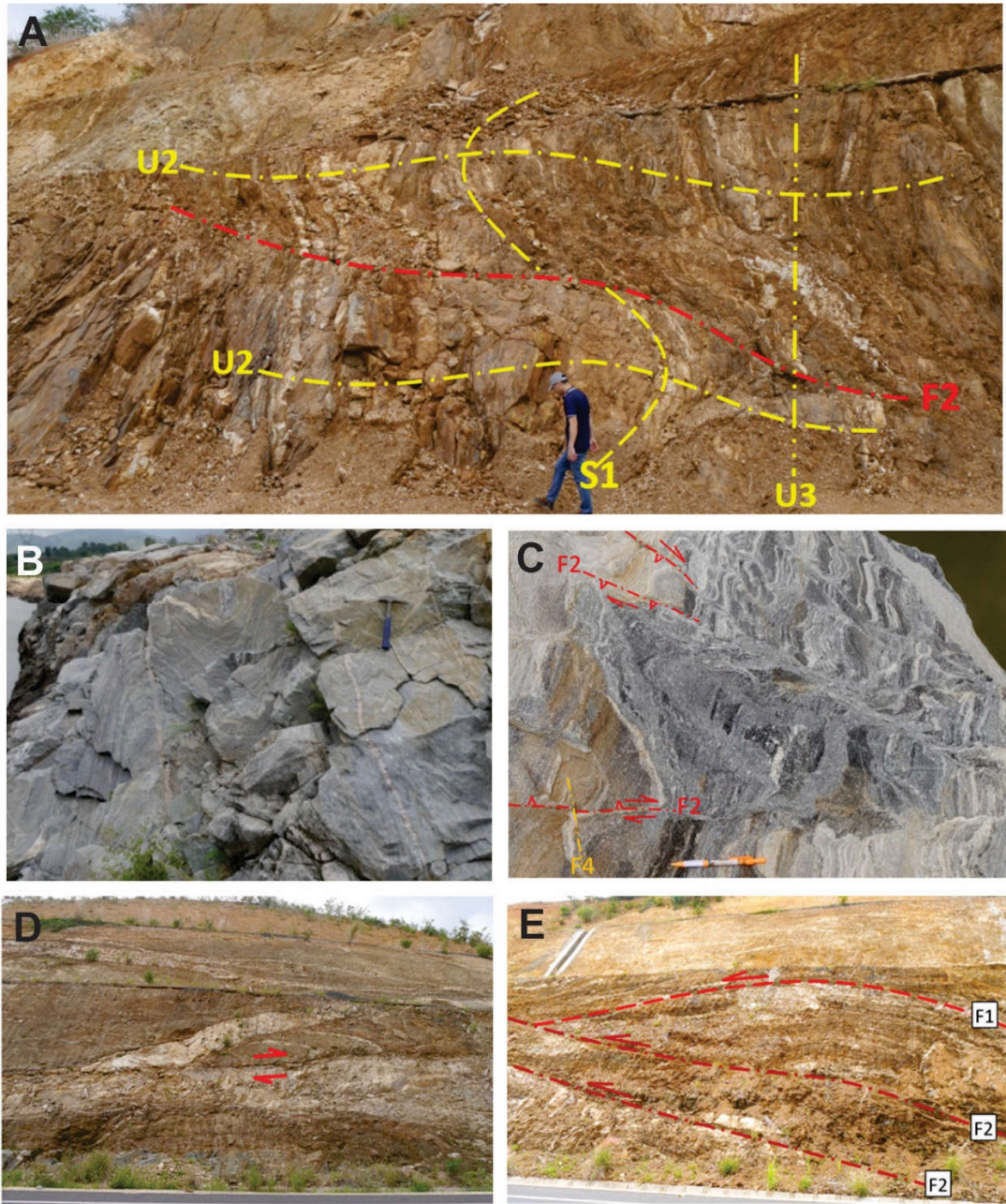


Figure 4. A: Relationship between first (S1), second (U2, F2) and third generation (U3) structures observed in the Kon Ray area showing complicated structural interference pattern, in which the D2 structures forming the dominant structural grain. B: An inclined, northeast verging second generation anticlinorium (U2) developed in high-grade rocks of Ngoc Linh Complex outcropped at Dak Bla Hydropower Station (photo looks northwesterly). D: An U2 inclined northeasterly verging anticlinorium associated with axial-plane oblique brittle-ductile, oblique shearing (F2) exposed at Dak Bla, hydropower station. The teeth of D2 shear point towards hanging wall of the shear zone. E and F: F2 shear zones cross-cut and modified F1 structures observed at southeast of Kon Tum Commun.

All pre-Cenozoic assemblages are intruded by plutons and pegmatitic dykes ranging in age from Silurian to Triassic (Carter et al., 2001; Nagy et al., 2001; Lepvrier et al., 2004; Trinh Van Long, 2009b). Despite decades of regional study, no systematic analysis of deformational geometry, kinematics, and age had been undertaken for the central Kon Tum Massif until recently (cf. Tran et al., 2014). This paper presents new structural and geochronological data on the Ngoc Linh Complex, with the aim of constraining its deformation history and tectonic significance within the regional Paleozoic framework.

2. Deformation of the Ngoc Linh Complex

Field relations show that the Ngoc Linh Complex is dominated by tectonic contacts rather than by primary stratigraphic continuity. Different lithologies occur as lensoidal or boudinage bodies enclosed in strongly foliated gneissic and mylonitic matrices. Regional shear zones are generally southeast-verging and define imbricate slices in which higher-grade rocks to the east structurally overlie lower-grade or mixed packages to the west. This style, together with the occurrence of folded shear fabrics and tectonic mélanges, indicates crustal shortening accompanied by strong ductile flow and transport toward the northwest–west.



Figure 5. Representative of third generation structures in the Ngoc Linh Complex seen in the Kon Tum area. A: The interference between D2 folds (U2) and D3 structures including F3 folds and F3 faults. B: A F3 fault infilled by quartz veins being cut by a fourth generation fault.

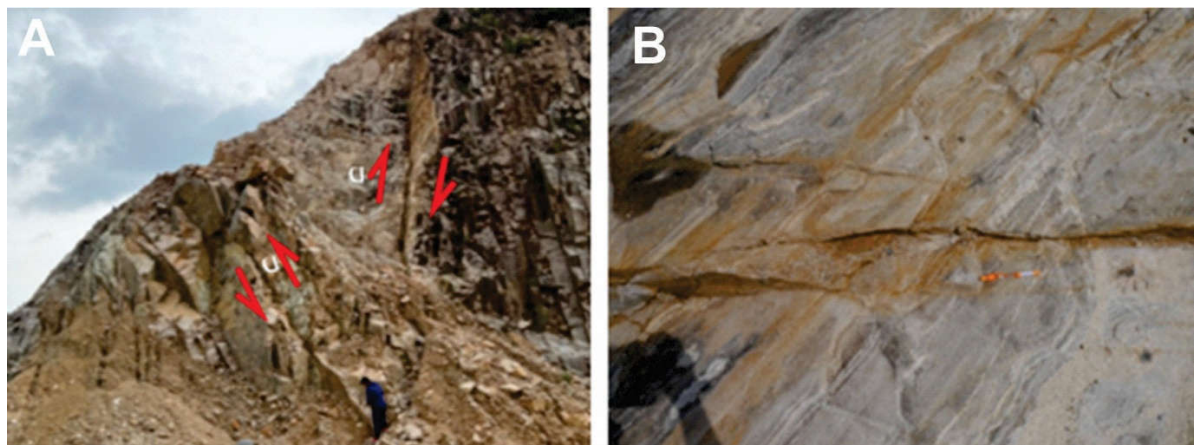


Figure 6. A: A northwest trending brittle, fault zone forming a positive flower structure cross-cut granitic rocks of Ben Giang – type complex seen in southwest of Kon Tum commune. B: A disserted en-echelon, dextral strike slip brittle fault of fifth generation observed at Dak Bla Hydropower Station

The first deformation (D1) is the most pervasive and is responsible for the penetrative schistosity S1, mylonitic foliation, asymmetric transposition fabrics, isoclinal to recumbent folds, sheath folds, and intense tectonic dismemberment. D1 fabrics define the main collisional architecture of the complex. They record emplacement of the Kan Nack Complex above the Ngoc Linh Complex and, in turn, structural telescoping of the Ngoc Linh Complex over younger and lower-grade western packages. The abundance of tectonic slices, strong shearing, and repeated rock packages suggests that the present outcrop pattern reflects ductile thrust stacking rather than original sedimentary order.

The second deformation (D2) folds and reworks D1 structures. It produced tight to chevron-style folds, northwest–southeast structural grain, and brittle–ductile reverse to oblique shear zones that locally cut or rotate earlier fabrics. In many outcrops, D2 is recognizable where S1 and earlier fold hinges are bent into later inclined folds. D2 therefore explains much of the current map-scale structural trend of the central Kon Tum Massif. On a regional scale, this event is compatible with the widespread Permian–Triassic reworking recognized elsewhere in the massif during Indosinian tectonism (Osanai et al., 2004; Nakano et al., 2013; Faure et al., 2018).

The third deformation (D3) is expressed by open to gentle upright folds and by localized brittle to brittle–ductile faults. Although D3 complicates interference patterns locally, it does not erase the dominant D1–D2 architecture. Deformations D4 and D5 correspond to younger brittle faulting and fracture-zone development. These later structures include normal, reverse, oblique-slip, and strike-slip faults that affect both metamorphic and intrusive rocks. Their influence is mainly local and geomorphic rather than regional-scale structural reorganization.

3. Tectonic implications

The structural evidence summarized above favors interpretation of the Ngoc Linh Complex as an exposed remnant of an Early Paleozoic collisional belt in east-central Indochina. The strongest argument is the D1 architecture: pervasive ductile thrusting, tectonic stacking of contrasting metamorphic packages, mélanges, and transport-parallel sheath and isoclinal folds. This structural style is much easier to explain by collisional shortening than by simple late extensional exhumation. Independent regional studies have documented Ordovician–Silurian magmatism and Early Paleozoic metamorphism in central Vietnam, supporting a Paleozoic orogenic framework for the earliest penetrative deformation (Usuki et al., 2009; Jiang et al., 2020; Burrett et al., 2021).

At the same time, the Ngoc Linh Complex was unquestionably reworked during later tectonothermal events. Permian–Triassic high-grade metamorphism, granitoid emplacement, and renewed deformation overprinted earlier fabrics across much of the Kon Tum Massif (Osanai et al., 2004; Nakano et al., 2013; Bui et al., 2020). In the study area, this reworking is best represented by D2, which imposed the present northwest–southeast structural grain upon an older collisional template. The complex therefore records a two-stage history: construction of a collisional crustal stack in the Early Paleozoic, followed by strong Indosinian thermal and structural modification.

This interpretation is significant for regional tectonics because it bridges the gap between local field observations in the Ngoc Linh area and broader models for the assembly of the eastern Indochina Block. In particular, the deformation style of the Ngoc Linh Complex is compatible with Early Paleozoic convergence linked to the Proto-Tethyan realm, whereas later Permian–Triassic tectonothermal overprinting reflects intracontinental reworking during the Indosinian event. The Ngoc Linh Complex thus preserves both the constructional fabric of an older orogen and the overprint of a younger regional thermal–tectonic pulse.

4. Conclusions

1) The Ngoc Linh Complex is a tectonically assembled, strongly dismembered metamorphic package rather than a simple coherent stratigraphic unit.

2) Five deformational events are recognized, but D1 and D2 are the key events controlling the present architecture.

3) D1 produced the principal collisional fabric set, including S1 schistosity, mylonitic thrust zones, mélanges, and isoclinal/sheath folds related to tectonic stacking.

4) D2 refolded and reactivated D1 structures and generated the dominant northwest–southeast regional grain of the central Kon Tum Massif.

5) The Ngoc Linh Complex is best interpreted as an exposed remnant of Early Paleozoic collisional tectonism that was substantially reworked during Permian–Triassic Indosinian tectonothermal events.

Acknowledgements

This study was supported by Vietnam’s National Foundation for Science and Technology Development (NAFOSTED), Project No. 105.01-2021.08.

References

- Bui, V. T. S., Osanai, Y., Nakano, N., Adachi, T., Kitano, I., and Owada, M. (2020). Timing of high-grade metamorphism in the Kon Tum Massif, Vietnam: Constraints from zircon-monazite multi-geochronology and trace elements geochemistry of zircon-monazite-garnet. *Journal of Asian Earth Sciences*, 187, 104084.
- Burrett, C., Udchachon, M., and Thassanapak, H. (2021). The Truong Son, Loei-Phetchabun, and Kontum Terranes in Indochina: Provenance, Rifting, and Collisions. *Frontiers in Earth Science*, 9, 603565.
- Faure, M., Nguyen, V. V., Luong, T. T. H., and Lepvrier, C. (2018). Early Paleozoic or Early-Middle Triassic collision between the South China and Indochina blocks: The controversy resolved? Structural insights from the Kon Tum massif (central Vietnam). *Journal of Asian Earth Sciences*, 166, 162-180.
- Gardner, C. J., Graham, I. T., Belousova, E., Booth, G. W., and Greig, A. (2017). Evidence for Ordovician subduction-related magmatism in the Truong Son terrane, SE Laos: Implications for Gondwana evolution and porphyry Cu exploration potential in SE Asia. *Gondwana Research*, 44, 139-156.
- Jiang, W., Yu, J. H., Wang, X., Griffin, W. L., Pham, T. H., Nguyen, D. L., and Wang, F. (2020). Early Paleozoic magmatism in northern Kontum Massif, Central Vietnam: Insights into tectonic evolution of the eastern Indochina Block. *Lithos*, 376-377, 105750.
- Nagy, E. A., Maluski, H., Lepvrier, C., Schärer, U., Phan, T. T., Leyreloup, A., and Vu, V. T. (2001). Geodynamic significance of the Kontum massif in Central Vietnam: Composite $^{40}\text{Ar}/^{39}\text{Ar}$ and U-Pb ages from Paleozoic to Triassic. *The Journal of Geology*, 109, 755-770.
- Nakano, N., Osanai, Y., Owada, M., Nam, T. N., Toyoshima, T., Binh, P., Tsunogae, T., and Kagami, H. (2007). Geologic and metamorphic evolution of the basement complexes in the Kontum Massif, central Vietnam. *Gondwana Research*, 12, 438-453.
- Nakano, N., Osanai, Y., Owada, M., Tran, N. N., Charusiri, P., and Khamphavong, K. (2013). Tectonic evolution of high-grade metamorphic terranes in Central Vietnam: Constraints from large-scale monazite geochronology. *Journal of Asian Earth Sciences*, 73, 520-539.
- Osanai, Y., Nakano, N., Owada, M., Nam, T. N., Toyoshima, T., Tsunogae, T., and Binh, P. (2004). Permo-Triassic ultrahigh-temperature metamorphism in the Kontum massif, central Vietnam. *Journal of Mineralogical and Petrological Sciences*, 99, 225-241.

- Roger, F., Maluski, H., Leyreloup, A., Lepvrier, C., and Phan, T. T. (2007). U-Pb dating of high-temperature metamorphic episodes in the Kon Tum Massif (Vietnam). *Journal of Asian Earth Sciences*, 30, 565-572.
- Tran, H.T., Zaw, K., Halpin, J.A., Manaka, T., Meffre, S., Lai, C.K., Lee, Y., Le, H.V., & Dinh, S. (2014). The Tam Ky–Phuoc Son shear zone in Central Vietnam: tectonic and metallogenic implications. *Gondwana Research*, 26 (1), 144–164.
- Tri, T. V., and Khuc, V. (eds.) (2009). *Geology and Earth Resources of Vietnam*. Publishing House for Science and Technology, Hanoi.
- Usuki, T., Lan, C.-Y., Yui, T.-F., Iizuka, Y., Vu, T. V., Tran, T. A., Okamoto, K., Wooden, J. L., and Liou, J. G. (2009). Early Paleozoic medium-pressure metamorphism in central Vietnam: Evidence from SHRIMP U-Pb zircon ages. *Geosciences Journal*, 13, 245-256.