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Reports

Geology of the Permian Higashimata Complex in the Nanjō Mountains, Fukui Prefecture, Southwest Japan

Satoshi Nakae[1, *]

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Abstract: The Nanjō Mountains cover an approximately 300 km^2 area of central Fukui Prefecture, in Southwest Japan. The mountains extend eastward from the east coast of Tsuruga Bay and are topographically separated from the surrounding mountains by high-angle faults. In terms of the geotectonic division, the Nanjō Mountains belong to the Ultra-Tamba belt to the north and to the Mino belt to the south, which are defined by Permian and Jurassic sedimentary complexes, respectively. These complexes are bounded by a northward-dipping low-angle fault.

The sedimentary complex distributed in the Ultra-Tamba belt in the Nanjō Mountains is called the Higashimata Complex, the main outcrops of which are observed in the northern margin of the mountains, and is thought to have formed along the convergent margin where the oceanic plate was subducting beneath the paleo-Asian continent during a late part of the Permian Period. The Higashimata Complex is primarily composed of terrigenous clastic rocks such as phyllitic mudstone and massive to stratified sandstone, together with lesser amounts of siliceous mudstone, felsic tuff and chert. Among these rocks, sandstone and phyllitic mudstone are the most dominant components, while felsic tuff and chert are rarely found in this complex. Generally speaking, the stratigraphic succession consists of phyllitic mudstone, interbedded mudstone and sandstone, and massive to stratified sandstone. Arranging these elements from the base to the top results in an upward-coarsening and thickening sequence. The basal phyllitic mudstone is normally up to 150 m thick, the interbedded sandstone and mudstone is 100–200 m thick, and the sandstone is 400–500 m thick. This succession is repeated several times in the complex, which has a total thickness of 5,200 m at the highest point.

The largest and principal structure of the Higashimata Complex is a broad east–west trending homocline, that dips gently to moderately northward. The general strike is approximately east–west trending, but it is weakly folded with northward-plunging axes. The main faults at the base and the upper sections of the Higashimata Complex are the basal low-angle fault and high-angle faults, respectively. The basal low-angle fault separates the Higashimata Complex from the underlying Mino sedimentary complex, although the movement along the fault plane is not clearly evident. In contrast, the high-angle faults pass in an approximately east–west trend and remove the upper sections of the Higashimata Complex, that were originally covered by the Cretaceous Asuwa Group.

Radiolarian fossil discoveries in the Nanjō Mountains have been reported in previous studies. These fossil assemblages primarily consist of genera *Follicucullus*, *Entactinia*, *Ishigaum*, *Pseudotormentus*, *Haplentactinia*, *Cauletella*, *Raciditor* and *Stigmosphaerostylus*, and were found in siliceous and tuffaceous mudstones at four localities. The age of the Higashimata Complex can be determined based on this radiolarian evidence, and indicates formation in the late Middle to Late Permian Period.

Keywords: Permian, Higashimata Complex, Ultra-Tamba belt, Nanjō Mountains, Fukui Prefecture, Southwest Japan

1. Introduction

This report is a review of the current knowledge related to the geology of the Permian sedimentary complex of the Ultra-Tamba belt in the Nanjō Mountains, and is written to describe the geological map that covers the northern margin of the mountains. It presents a regional overview and gives a detailed account of area's stratigraphy and lithology. Mapping in the Nanjō Mountains was conducted from 2001 to 2008 by the

[1]AIST, Geological Survey of Japan, Institute of Geology and Geoinformation

[*]Corresponding author: S. NAKAE, Central 7, 1-1-1 Higashi, Tsukuba, Ibaraki 305-8567, Japan. Email: nakae-satoshi@aist.go.jp

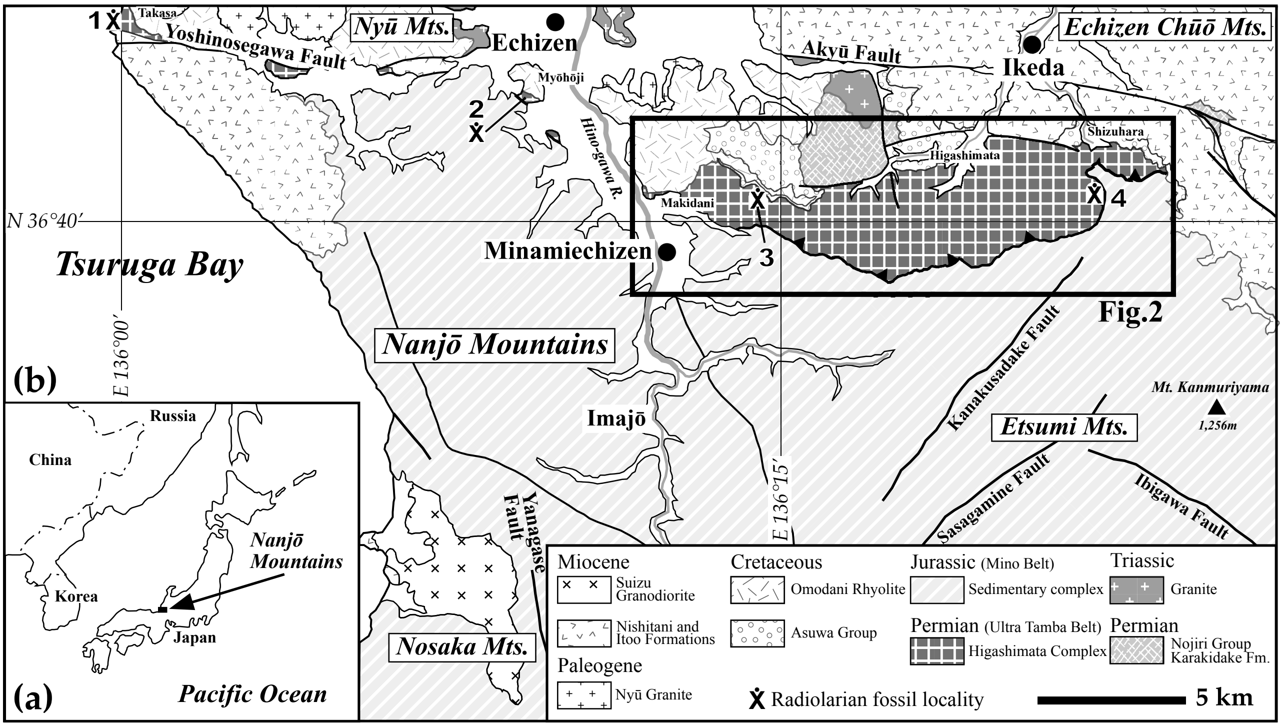

Figure. 1 Index map showing the location of the Nanjō Mountains (a) and geological sketch map of the Nanjō and surrounding mountains (b).
The rectangular frame indicates distribution area of the Higashimata Complex. Symbols with a number indicate fossil localities; 1 at Takasa, 2 at Myōhōji, 3 at east of Makidani, and 4 at south of Shizuhara. Compiled from Fukui Prefecture (1955, 1969), Wakita *et al*. (1992), and unpublished data. Mts.: Mountains., R.: River, Fm.: Formation.

mapping project of the Geological Survey of Japan (GSJ). The full text of 'Geology of Imajō and Takenami district' and 'Geology of the Kanmuriyama district' along with 1:50,000 geological maps (quadrangle series) will be published in the near future.

The Nanjō Mountains occupy a central area of Fukui Prefecture, in Southwest Japan (Figure 1a) and extend eastward from the east coast of Tsuruga Bay to the border zone of the Etsumi Mountains (Figure 1b), covering an area of approximately 300 km^2. The Nanjō Mountains are topographically separated from the surrounding mountains by high-angle faults. To the north, they are separated from the Nyū Mountains by the Yoshinosegawa Fault, and from the Echizen Chūō Mountains by the Akyū Fault. To the south, they are separated from the Nosaka Mountains by the Yanagase Fault, and from the Etsumi Mountains to the east by the Kanakusadake Fault.

The Nanjō Mountains are primarily underlain by sedimentary complexes, which are unconformably covered by Cretaceous to Miocene siliciclastic and volcaniclastic rocks and intruded upon Paleogene and Miocene granitic rocks. On the basis of the lithology and stratigraphical relation, the sedimentary complexes distributed in the Nanjō Mountains have been divided into the two following units. The first is a Permian complex, called the Higashimata Complex, which consists primarily of massive to stratified sandstone and phyllitic mudstone, belonging to the Ultra-Tamba belt. This complex is exposed in the northern margin of the Nanjō Mountains. The second is a Jurassic complex of the Mino belt (abbreviated as the Mino sedimentary complex in this report for the sake of convenience), which is composed of predominant chert, mudstone and sandstone and accompanied by lesser amounts of basalt and limestone. This complex is distributed throughout the Nanjō, Etsumi and Nosaka Mountains. The Permian complex overlies the Mino sedimentary complex at a low-angle fault or thrust. A geological sketch map of the mountains is shown in Figure 1.

In the next sections, the Higashimata Complex of the Ultra-Tamba belt in Nanjō Mountains will be defined and described in greater detail.

2. History of survey

The Permian system (Higashimata Complex) distributed in the Nanjō Mountains is an accretionary complex that belongs to the Ultra-Tamba belt (Caridroit *et al*., 1985) in Southwest Japan. This belt is situated between the Maizuru belt to the north and the Tamba belt to the south, and its type locality occupies the area covering southern Maizuru City and northeastern Ayabe City, Kyoto Prefecture.

The first geological survey of the Permian system in the Nanjō Mountains, that is equivalent to those of the Ultra-Tamba belt, was carried out by Otsuki and Kiyono (1919) in the course of mapping the region on a scale of 1:200,000. That map, which covers a larger area than is discussed in this account, was published on quadrangle 'Tsuruga' sheet. In this research, the Permian system was regarded as a member of the so-called Chichibu Paleozoic System. After that pioneer study, no further research was conducted until the 1950s. However, a geological compilation map of the geology of the prefecture (drawn on a scale of 1:200,000), that includes the Nanjō Mountains was produced by the Fukui Prefecture government in 1955, and then revised for a second edition (on a scale of 1:150,000) in 1969.

Taking all the above sources into consideration, it can be said that predominant massive to stratified sandstones and phyllitic mudstones, called the Higashimata Formation, are widely distributed in the northern margin of the Nanjō Mountains, which can thus be inferred to be date from the late Permian Period, or even afterwards (Fukui Prefecture, 1955, 1969). In 2010, the Fukui Prefecture government produced a third edition of the renewal-compiled map, this time on a scale of 1:100,000 (Fukui Prefecture, 2010).

Nakaya and Saito (1986) described the general geology and structure of the Higashimata Formation obtained from their detailed survey around Higashimata, Ikeda Town. With respect to the age of the formation, they inferred that the formation occurred during the early Jurassic to late Cretaceous Periods based on the stratigraphic relationship between underlying and overlying strata. From the siliceous mudstone on the east coast of Tsuruga Bay, at Takasa, Echizen Town, where a western extension of the Higashimata Formation exists, late Middle to Late Permian radiolarian fossils have been detected (Umeda, 1986; Umeda and Hattori, 1987), and similar fossils have also been found in the Nanjō Mountains (Umeda, 1996; Umeda *et al.*, 1996; Nakae, 2011). Based on the petrological characteristics of the sandstone (Umeda, 1987) together with the occurrence of the above-mentioned fossils, Umeda *et al.* (1996) concluded that the Higashimata Formation could be correlated to the stratotype section of the Permian accretionary complex of the Ultra-Tamba belt.

The systematic large-scale mapping of most areas of the mountains on the quadrangle Series Maps (1:50,000) by the GSJ was completed in 2008 and will be published on the new map sheets for the 'Imajō and Takenami' and 'Kanmuriyama' districts by the present author and his co-geological surveyors in the near future. Hereafter, the Higashimata Formation will be referred to as the Higashimata Complex.

3. Outline of geology

In general terms, plate subduction during the late part of the Permian Period resulted in sediment accretion along the convergent margin in front of paleo-Asian continent to form the sedimentary complex of the Ultra-Tamba belt (*e.g.*, Caridroit *et al.*, 1985; Ishiga, 1986a; Kimura, 1988). The sedimentary complex of this belt commonly consists of terrigenous clastic rocks such as sandstone and phyllitic mudstone, together with lesser amounts of siliceous mudstone, felsic tuff, chert, limestone and basalt.

In the Nanjō Mountains, the Higashimata Complex occurs in an east–west trend approximately 18 km long with 1 to 4 km wide, and has an ESE–WNW strike in the western area, an east–west strike in the central area and an ENE–WSW strike in the eastern area (Figure 2). It also possesses a gently to moderately northward dip that displays a homoclinal structure (Figure 3), and which crops out in a few narrow areas on the south of the Yoshinosegawa fault (Figure 1).

The Higashimata Complex is bounded with the underlying Mino sedimentary complex by the northward-dipping low-angle fault or thrust. It is unconformably overlain by Cretaceous nonmarine siliciclastic deposits (Asuwa Group) and felsic volcanic rocks (Omodani Rhyolites) as well as Miocene andesite volcaniclastic rocks (Nishitani and Itoo formations). Internally, the stratigraphic succession consists of phyllitic mudstone, interbedded mudstone and sandstone, and massive to stratified sandstone, arranged from the base to the top in several repetitions. The overall thickness of the complex decreases appreciably from 5,200 m in the central area to 1,900 m in the western area and 460 m in the eastern area. This change in thickness is possibly due to post-depositional erosion by the overlying formations during periods of uplift in the late Cretaceous Period.

4. Higashimata Complex

The main outcroppings of the Higashimata Complex are observed in the northern margin of the Nanjō Mountains, east of central Minamiechizen Town (formerly Nanjō Town) and south of central Ikeda Town in Fukui Prefecture, while small outcroppings lie along the Yoshinosegawa Fault, which divides the Nanjō Mountains from the Nyū Mountains (Figure 1).

4.1. Name

The term 'Higashimata Formation' was originally included in the graduation thesis of Soichiro Kida, which was submitted to Kanazawa University in 1954, and first appeared in the literature published by Fukui Prefecture (1969). However, the name is not acceptable as a formal stratigraphic unit designation, because such formal names require a significant amount of justification. Furthermore, the literature by Fukui Prefecture (1969) did not provide any definitions of the type locality and stratotype of the Higashimata Formation. Therefore, the name should be disaffirmed or redefined.

Nevertheless, it is felt that the 'Higashimata' portion of the geographic name should be retained due to

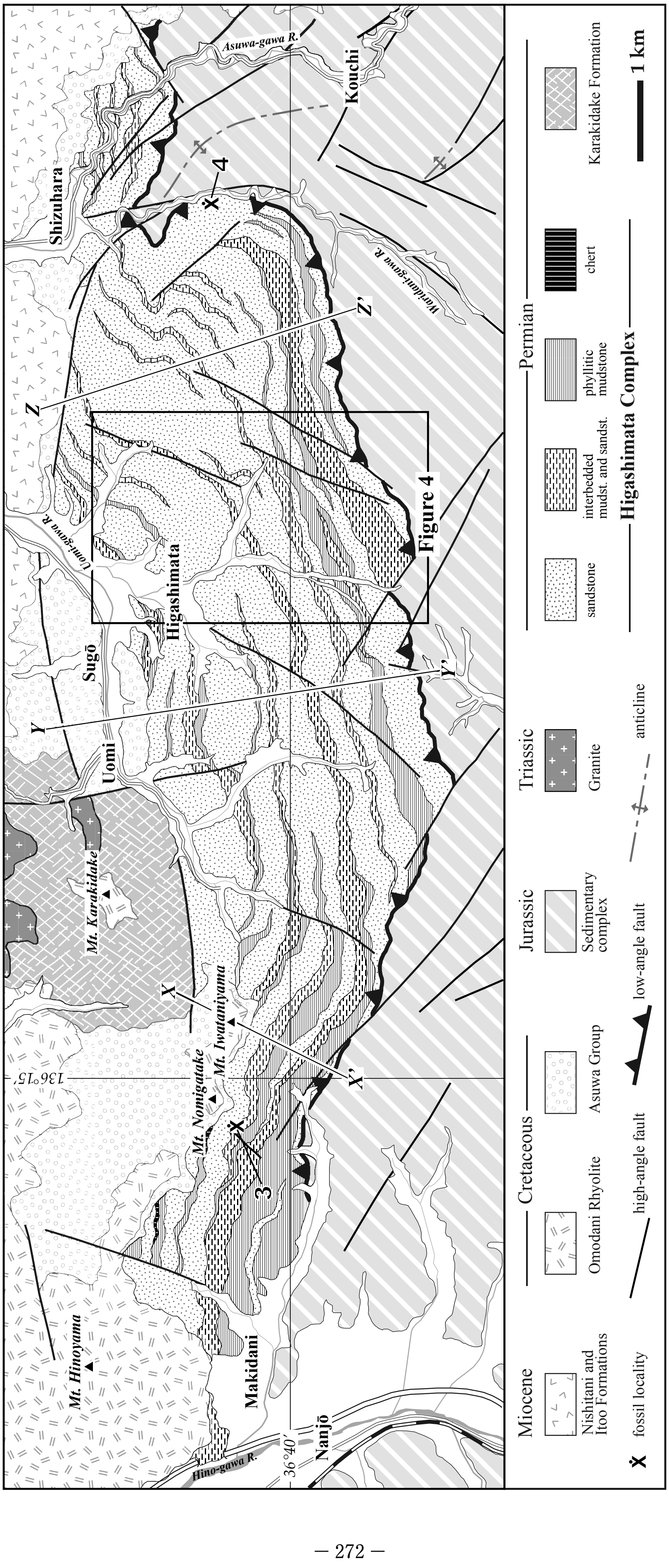

Figure. 2 Geological map of the Higashimata Complex in the Nanjō Mountains.

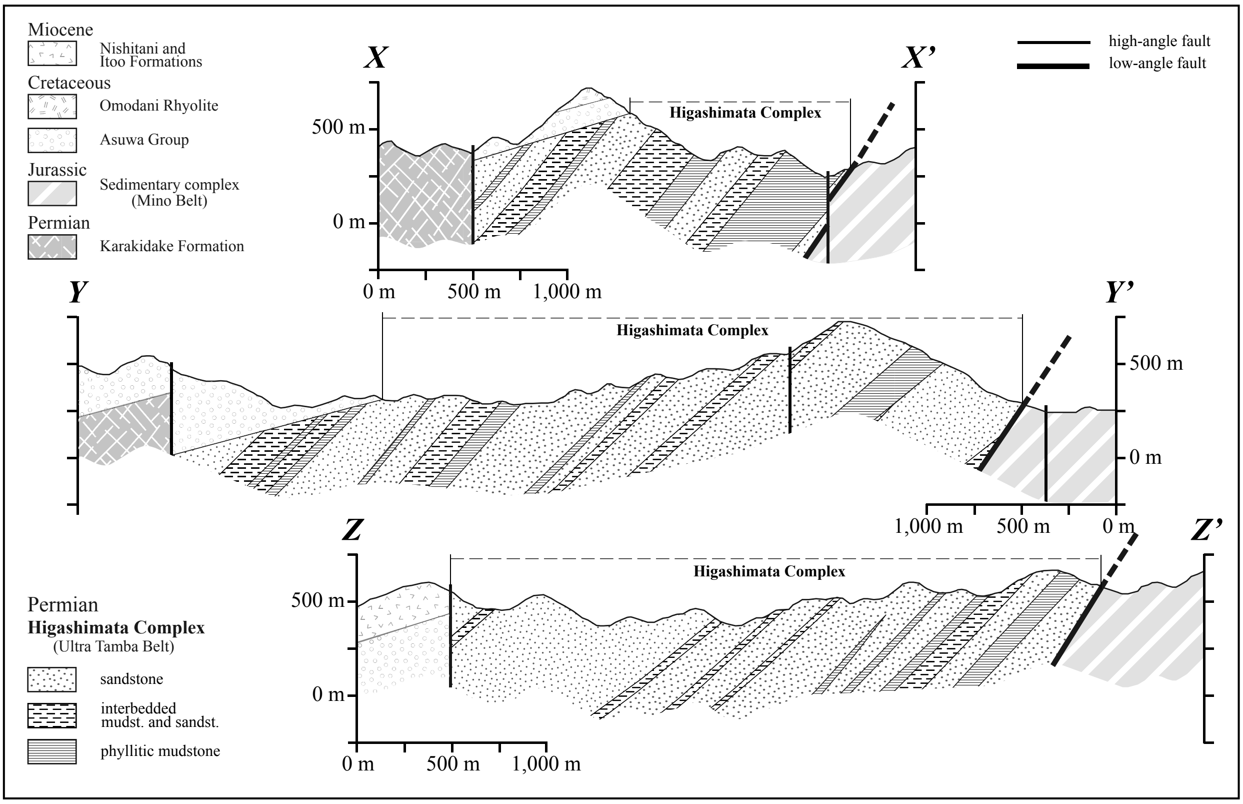

Figure. 3 Geological profiles of the Higashimata Complex in the Nanjō Mountains.
Locations of transection lines *X–X'*, *Y–Y'* and *Z–Z'* are shown in Figure 2.

following reasons: the formation is typically exposed around Higashimata as described by Kida, and the name 'Higashimata' has been in longstanding and common usage to date. Consequently, the name is formally redefined in this report to conform to the modern rules and procedures (Salvador, 1994) by changing the unit type. In the present case, as mentioned below, this unit is characterized by moderately complicated structural relations to the extent that the original sequence of the component rocks is somewhat obscured. Furthermore, the stratigraphic relations of the individual lithologies that form the rock body of this unit are unidentifiable. Thus, because the unit cannot be subdivided on stratigraphic grounds, the term 'complex' is appended to the name of this formal stratigraphic unit.

4.2. Stratotype and type locality

The stratotype and type locality of the Higashimata Complex have not been formally defined in any previous works. Therefore, in this paper, the stratotype is specified as beginning at the south of Higashimata, Ikeda Town in Fukui Prefecture (Figure 4). Outcrops along the forest roads from Higashimata are sporadically (rather than continuously) distributed, but typically represent the litho-stratigraphic feature of this complex.

4.3. Regional aspects

The Higashimata Complex occupies an area of approximately 30 km long (east–west trending) and between 1 and 5 km wide (north–south trending) along the northern margin of the Nanjō Mountains, ranging from an area southwest of Echizen City and travelling through the southern foot of Mts. Hinoyama, Nomigatake and Iwataniyama, which are south of Ikeda Town and southwest of Ōno City. It is also exposed on the coastal area at Takasa, Echizen Town.

Tectonically, the Higashimata Complex lies on the Mino sedimentary complex, being caused by a low-angle fault. This feature is well developed in the south of Higashimata. Its top is unconformably overlaid by the Cretaceous Asuwa Group and Omodani Rhyolites (Tsukano and Miura, 1959; Matsuo, 1962; Fukui Prefecture, 1969). The thickness of the Higashimata Complex extends up to 5,200 m (Figure 5).

4.4. Stratigraphy

The Higashimata Complex is approximately 5,200 m thick around Higashimata (columns d and e in Figure 5) in the central area, generally decreasing to 1,900 m at Makidani in the west (column a) and to 460 m at Shizuhara in the east (column h). This change in thickness is though to be due to the following two movements. The first is that the lower sections of the Higashimata Complex were cut off by a low-angle fault, which separated it from the Mino sedimentary complex. The

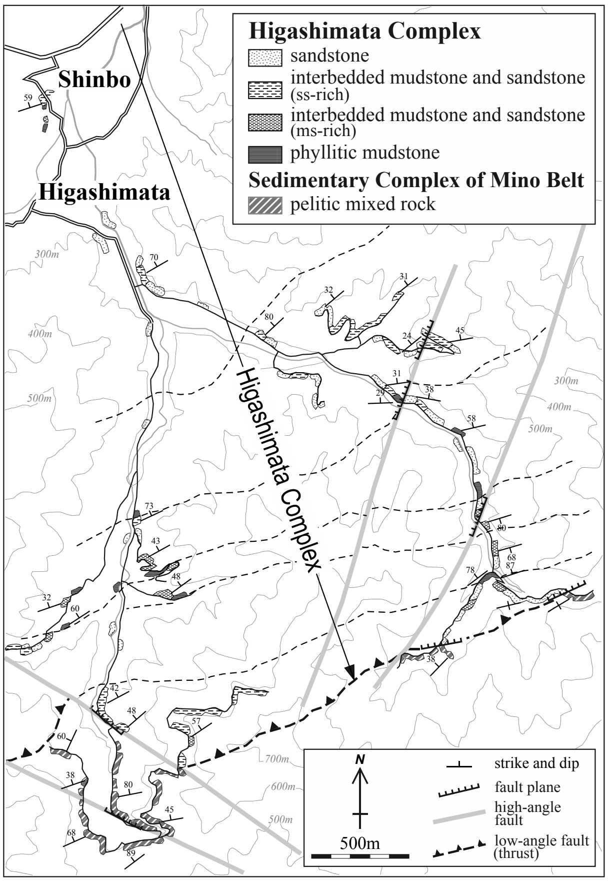

Figure. 4 Stratotype of the Higashimata Complex.
These two routes are equivalent to the columns d and e, which are shown in the figure 5. Broken lines are the traces of lithostratigraphic boundaries.

other is that the upper sections were removed by post-depositional erosion before the deposition of the overlying Asuwa Group.

The Higashimata Complex is mainly composed of phyllitic mudstone and sandstone, together with lesser amounts of chert and felsic tuff. Generally speaking, the phyllitic mudstone, interbedded mudstone and sandstone, and sandstone (which is arranged from lower to upper sections) displays an upward-coarsening and thickening sequence, and it is likely that the sequence is repeatedly exposed at least seven times (Figure 5). The basal phyllitic mudstone averages 150 m thick (350 m thick at maximum). In the middle and upper sections, the interbedded mudstone and sandstone (100–200 m thick) and sandstone (400–500 m thick) are randomly exposed (Figure 5).

4.5. Lithology

The lithological variation of the Higashimata Complex has been documented in detail in previous surveys (Nakaya and Saito, 1986; Umeda, 1987). These studies provided a wealth of information, especially on the sandstone that is the most predominant component of the complex. As mentioned above, the Higashimata Complex consists of predominant sandstone and phyllitic mudstone, together with lesser amounts of chert and felsic tuff.

(1) Chert

This stone is generally gray to light gray in color, and intercalated with siliceous mudstone, but occasionally the bedding is faintly observed (Figures 6a and b). The chert in this complex is commonly several centimeters thick, and the thin layers of siliceous mudstone are less than 5 mm.

(2) Phyllitic mudstone

This stone is generally black or dark gray in color, but appears dark brown where intensely weathered. This mudstone is intensely foliated and tends to split along the foliation (Figure 6c). The foliation is defined by the planar alignment of clay minerals such as illite. In addition, two types of the mudstone can be observed. One is the siliceous mudstone that is less than one centimeter thick and which is locally intercalated with the phyllitic mudstone. The other is the silty laminae that develops in phyllitic mudstone (Figures 6d and 8a). In situations where silty laminae are intercalated, the mudstone is commonly coarser than the normal types.

(3) Felsic tuff

Felsic tuff is light gray to pale gray in color, and is observed in thin layers several centimeters thick within the phyllitic mudstone (Figure 6e) or as tuffaceous mudstone (Figure 6f). It consists solely of fine grains of quartz within a much finer matrix (Figure 8b).

(4) Interbedded mudstone and sandstone

Mudstone and sandstone are divided into two types in terms of the thickness of sandstone beds; one is thinly and the other is thickly interbedded types. Mudstone is predominant in the thinly interbedded type (mudstone-rich), which is characterized by sandstone beds less than 30 cm thick (Figure 7a). In contrast, sandstone predominates in the thickly interbedded type (sandstone-rich), whose thickness ranges from 30 cm to 100 cm, and occasionally up to 300 cm, whereas intercalated mudstone is commonly less than 50 cm thick. (Figure 7d). The stratification composed by the rhythmical alternation of mudstone and sandstone is often dismembered in various degrees of deformation (Figures 7b and 7c).

(5) Massive sandstone

Where sandstone is primarily homogeneous, its thickness often exceeds more than 100 cm, and is characterized by massive and monotonous lithology due to the absence of sedimentary structures (Figures 7e and 7f). However, it is often intercalated with phyllitic mudstone beds less than 10 cm thick, which is exposed as stratified sandstone.

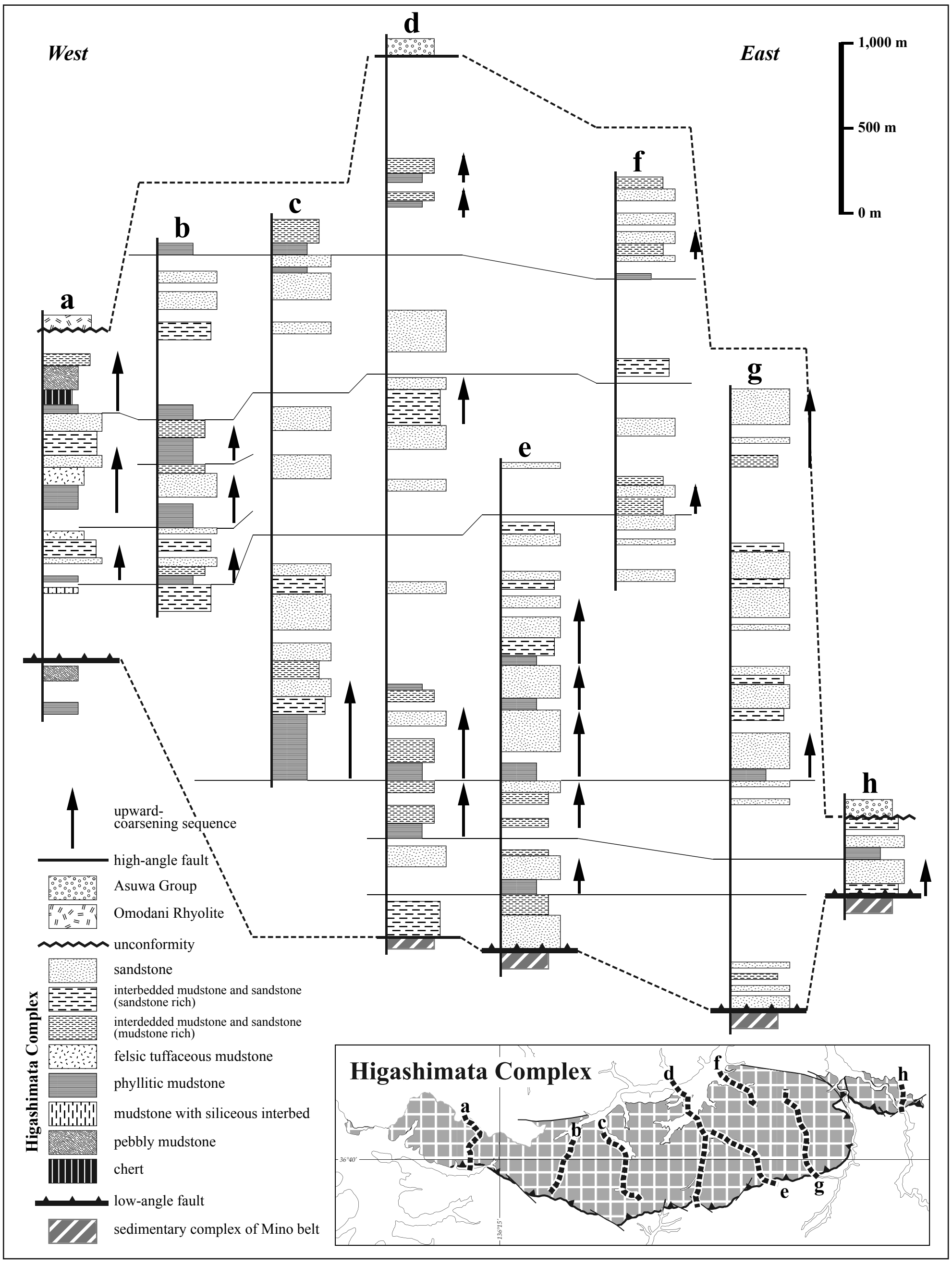

Figure. 5 Representative stratigraphic columns of the Higashimata Complex in the Nanjō Mountains.
Localities of each transect and column are as follows. a: east of Makidani, b–c: south of Uomi, d–e: south of Higashimata, f: Higashikakuma, g: east of Mt. Ōgoyasan, h: south of Shizuhara. Localities a and b are included in Minamiechizen Town, and remainings are in Ikeda Town. Thin lines are the traces of lithostratigraphic boundaries. The bottom and top of the Higashimata Formation are indicated by the broken lines.

This stone is pale to greenish gray in color, changing to brown or white where it is intensely weathered. Sandstone consists of medium to coarse, angular to subangular clastic grains, which are dominated by quartz and plagioclase with potassium feldspar, chlorite, mica and lithic fragments within a finer matrix (Figure 8c), generally occurring as a poorly sorted feldspathic wacke (Figure 9). Very coarse-grained sandstones commonly contain granules of sandstone, chert, volcanic rock and others. A meshwork structure consisting of 1–2 mm-wide calcite veins is well developed. The matrix, which locally has a calcareous component (Figure 8d), consists of chlorite, mica and unidentified fine-grained minerals. The micas and chlorites have a shape-preferred orientation. This sandstone is massive in appearance, but is commonly sheared and affected

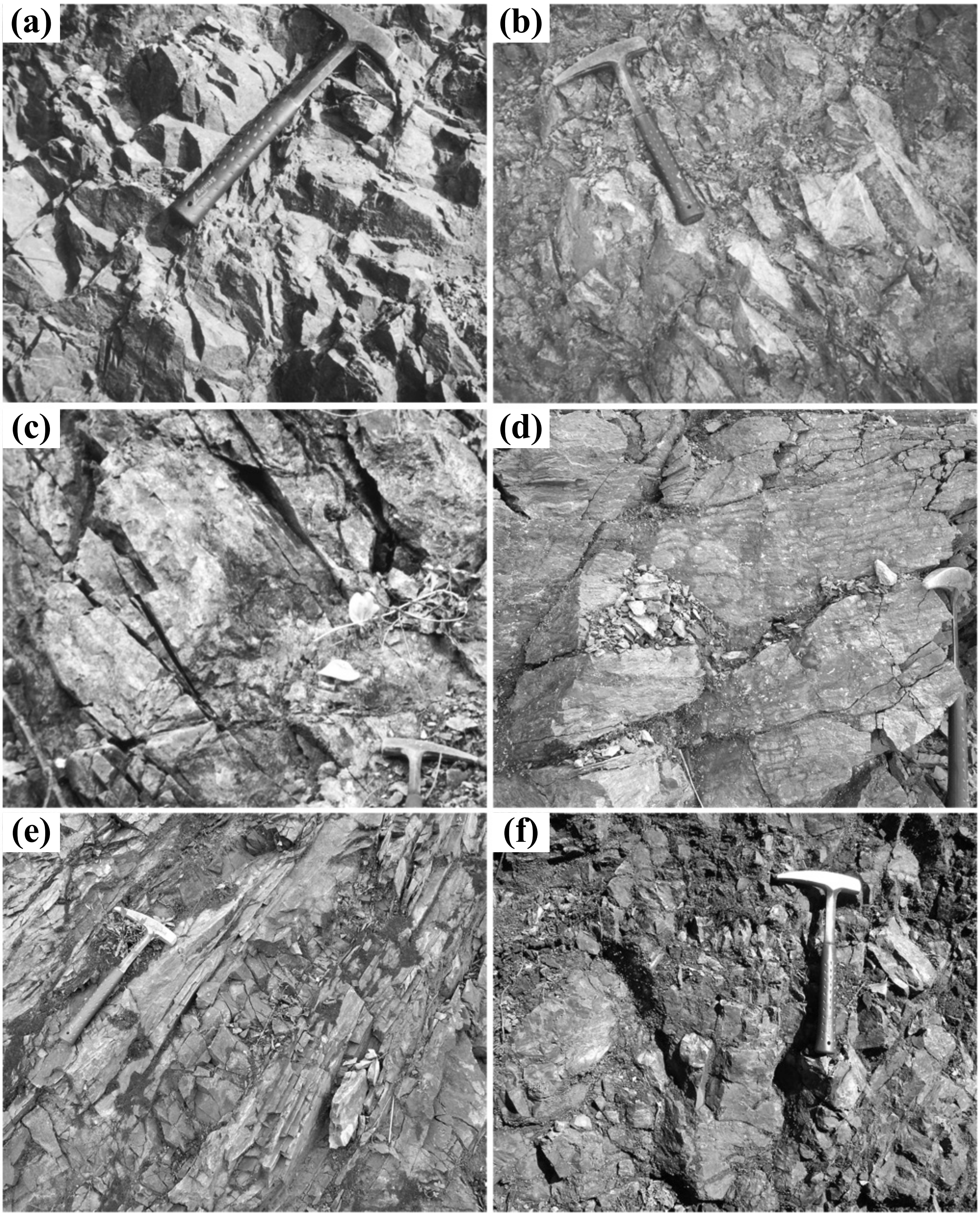

Figure. 6 Field photographs showing occurrence and lithology of main component rocks of the Higashimata Complex in the Nanjō Mountains (I).
(a)–(b) Cherts at Makidani, Minamiechizen Town, (c) Phyllitic mudstone at Makidani, Minamiechizen Town, (d) Laminated mudstone at Uomi, Ikeda Town, (e) Interbedded mudstone and felsic tuff at Uomi, Ikeda Town, and (f) Tuffaceous mudstone at Uomi, Ikeda Town.

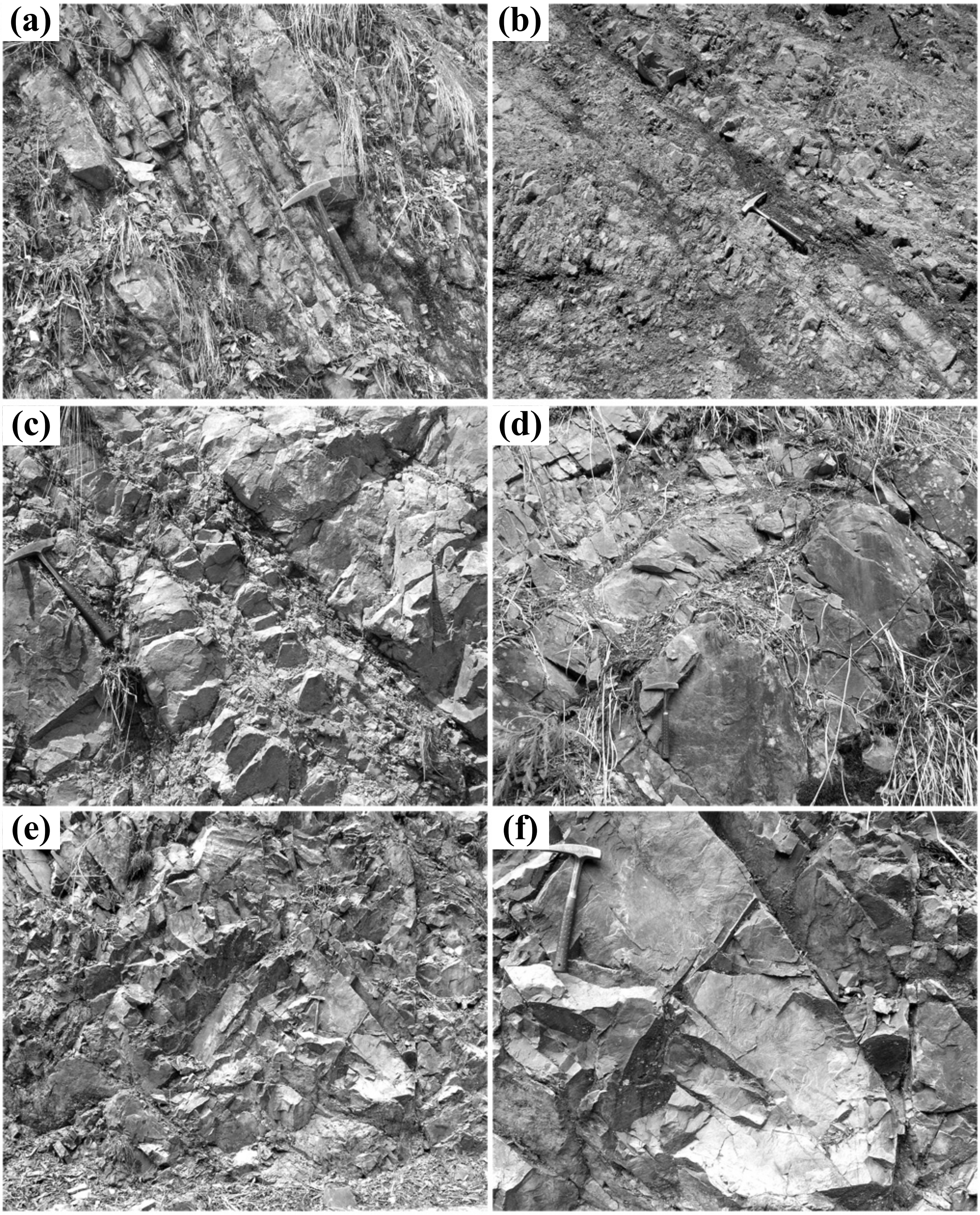

Figure. 7 Field photographs showing occurrence and lithology of main component rocks of the Higashimata Complex in the Nanjō Mountains (II).
(a) Thinly interbedded mudstone and sandstone (mudstone-rich), (b) Dismembered interbedded mudstone and sandstone (mudstone-rich) at Mt. Iwataniyama, (c) Dismembered interbedded mudstone and sandstone (sandstone-rich), (d) Thickly interbedded mudstone and sandstone (sandstone-rich), (e)–(f) Massive sandstone (e), and its close up (f). All outcrops excluding photo (b) are located around Uomi, Ikeda Town.

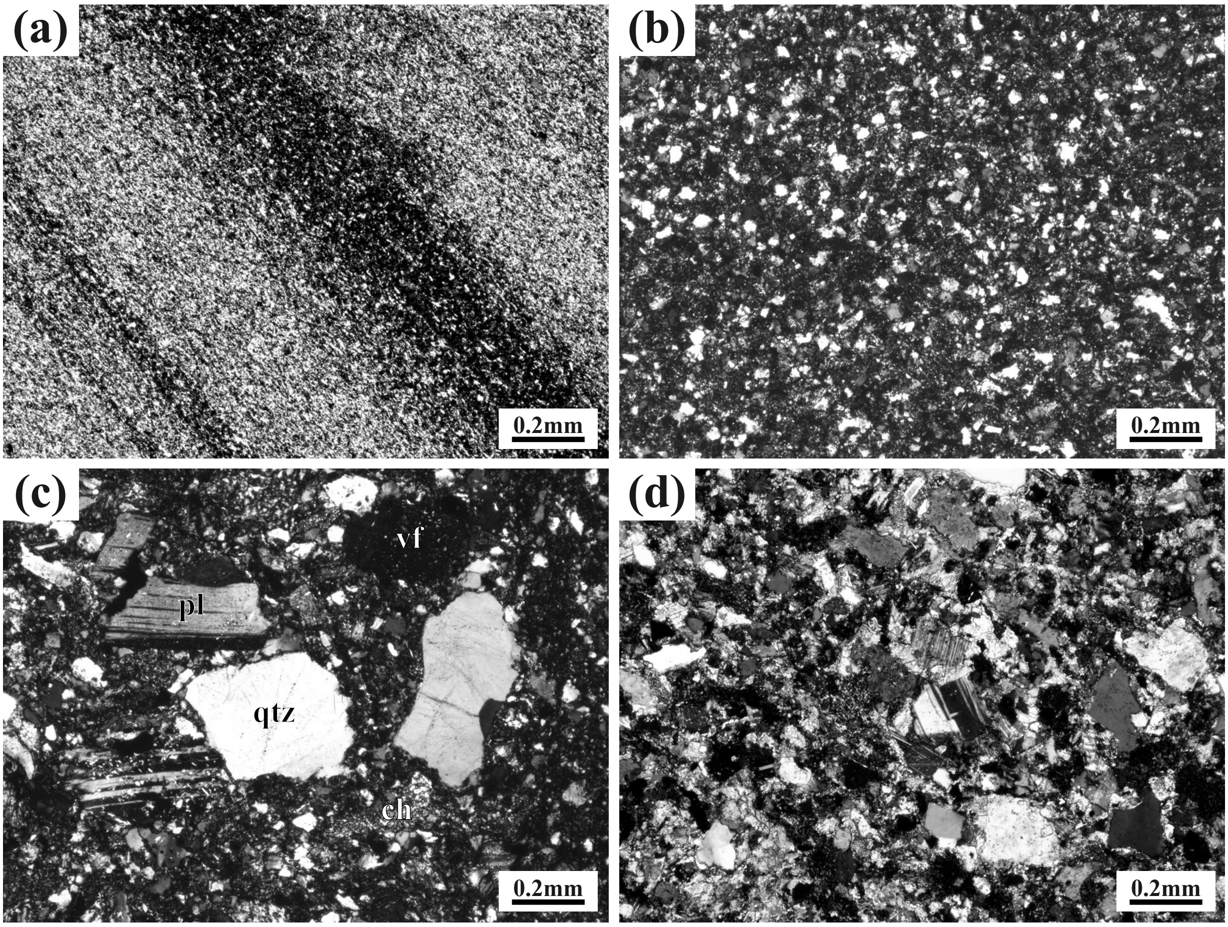

Figure. 8 Thin-section photomicrographs of each lithology of main component rocks of the Higashimata Complex in the Nanjō Mountains.
(a) Laminated mudstone, (b), Tuffaceous mudstone, (c) Coarse-grained sandstone, and (d) Medium-grained sandstone with calcareous matrix. qtz: quartz, pl: plagioclase, vf: volcanic rock fragment, ch: chert fragment.

by cataclastic deformation. Pressure shadows consisting of clay minerals are formed around most quartz and plagioclase grains, and the margins of these grains has commonly been dissolved and embayed (Figure 8c).

4.7. Geologic structure

The largest and principal structure of the Higashimata Complex is relatively simple, being dominated by a broad east–west trending homocline that dips gently to moderately northward. The general dip and strike are almost coincident with those of the underlying Mino sedimentary complex.

North–south trending geologic profiles traverse the three areas of the Higashimata Complex. One line passes east of Makidani in the western area and shows a moderately northward dipping of the component rocks of the complex (*X–X'* in Figure 3). The remaining two lines, one west of Higashimata in the central area and the other west of Shizuhara in the eastern area, also illustrate a northward dipping (*Y–Y'* and *Z–Z'* in Figure 3). However, the dips are slightly gentler than those in the western area.

The general strike is approximately east–west trending, but is weakly folded with northward-plunging axes. Furthermore, the strike gently changes from WNW–ESE trend in the western area east of Makidani to ENE–WSW trend in the central area around Higashimata and the eastern area west of Shizuhara (Figure 10).

The main faults at the base and the upper sections of the Higashimata Complex are the basal low-angle fault and high-angle faults, respectively. The basal low-angle fault passes parallel to the general strikes and separates the Higashimata Complex from the underlying Mino sedimentary complex as mentioned above (Figure 2), but the movement along the fault remains unclear. For example, this feature is well developed on the forest-road cut outcrop at south of Higashimata, where the interbedded mudstone and sandstone (sandstone-rich) and the massive sandstone of the Higashimata Complex overlies on the pelitic mixed rock of the Mino sedimentary complex through the fault (Figures 4 and 5).

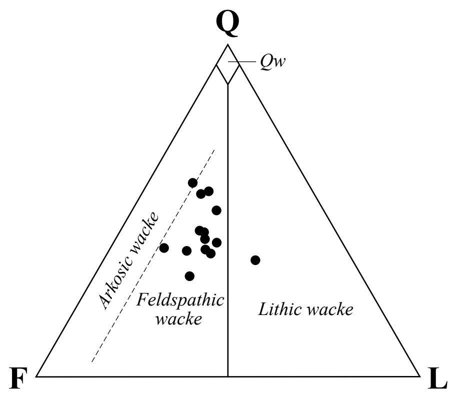

Figure. 9 Classification of sandstones of the Higashimata Complex in the Nanjō Mountains.
Abbreviations are as follows. Q: quartz, F: feldspar, L: lithic fragment, P: plagioclase, K: potassium feldspar, Qw: Quartz wacke. Data source is from Nakaya and Saito (1986).

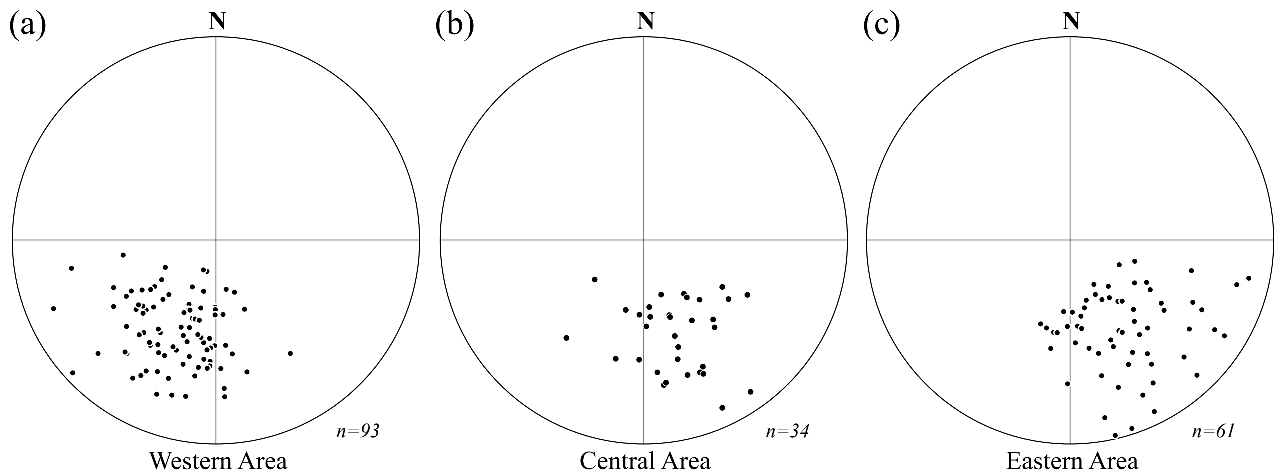

Figure. 10 Strikes and dips of the Higashimata Complex in the Nanjō Mountains.
Lower hemisphere of stereo (schmit net) projection. (a): western part east of Makidani, (b): central part around Higashimata, (c): eastern part west of Shizuhara.

However, the high-angle faults pass in an approximately east–west trend from the south of Mt. Karakidake to the west of Shizuhara. They remove the upper setions of the Higashimata Complex, which was originally covered by the Cretaceous Asuwa Group (Figure 3).

4.8. Fossil and Geologic age

Radiolarian fossil occurrence has been reported at four localities in the Nanjō Mountains in previous studies. They are: Takasa, Echizen Town (Locality 1); Myōhōji, Echizen City (Locality 2); east of Makidani, Minamiechizen Town (Locality 3); and south of Shizuhara, Ikeda Town (Locality 4). See Figures 1 and 2. The radiolarian species identified are listed in Table 1.

Radiolarian fauna consisting primarily of *Follicucullus scholasticus* Ormiston et Babcook, *Pseudoalbaillella*? sp., "*Deflandrella*" sp. (*Kimagior* is now used as the replacement name for *Deflandrella*: Sugiyama, 2000), and *Entactinia*? sp. has been obtained from siliceous mudstone, which is intercalated with fine-grained sandstone laminae at locality 1 (Umeda, 1986; Umeda and Hattori, 1987). Radiolarian fauna composed of *Follicucullus scholasticus* Ormiston et Babcook, *Follicucullus porrectus* Rudenko, *Follicucullus ventricosus* Ormiston et Babcook, *Follicucullus* sp. cf. *F. charveti* Caridroit et De Wever, "*Nazarovella*" sp. (*Racidior* is now used as the replacement name for *Nazarovella*: Sugiyama, 2000), *Pseudotormentus* sp. and *Haplentactinia* sp. has been found in the siliceous mudstone included in sandstone-rich interbedded mudstone and sandstone at locality 2 (Umeda, 1996). Umeda *et al*. (1996) reported that the siliceous mudstone examined

Table 1 List of radiolarian species obtained from the Nanjō Mountains.

Locality no.	1		2	3		4	
Lithology	sil ms - ms					sil ms	tuff ms
Sample no.	KM03	MY03		A	B	KJ 5205A	KJ 5205B
Albaillella? sp.			+				
Follicucullus scholasticus	+		+	+	+		
Follicucullus porrectus			+	+	+		
Follicucullus ventricosus			+				
Follicucullus bipartitus				+	+		
Follicucullus sp. cf. *F. charveti*			+	+	+		
Follicucullus spp.			+	+	+		
Follicucullus? sp.			+				
Pseudoalbaillella sp.				+	+		
Pseudoalbaillella? sp.	+						
Albaillellidae? gen. indet.							+
Latentifistula sp.						+	
Pseudotormentus sp.			+				
Cauletella manica							+
Cauletella sp.						+	
Ishigaum sp. cf. *I. trifustis*							+
Ishigaum sp. cf. *I. obesum*							+
Raciditor sp.						+	
"*Deflandrella*" sp.	+		+	+	+		
"*Nazarovella*" sp.			+	+			
Latentifistulidae gen. indet.						+	+
Copiellintra? sp.							+
Cenosphaera? sp.						+	
Srakaeosphaera sp. cf. *S. minuta*						+	
Stigmosphaerostylus sp.						+	+
Stigmosphaerostylus? sp.						+	
Haplentactinia sp.			+	+			
Entactinia sp.				+	+		
Entactinia? sp.	+	+					
Entactinosphaera sp.				+			
Reference	Umeda (1986)		Umeda (1996)	Umeda *et al.* (1996)		Nakae (2011)	

at locality 3 showed radiolarian fauna that was nearly identical to that present at locality 2, and identified the fauna as the equivalent of the *Follicucullus bipartitus*–*Follicucullus charveti* Assemblage proposed by Ishiga (1986b). Recently, Nakae (2011) reported an additional occurrence of radiolarian fossils found in siliceous and tuffaceous mudstones at locality 4. There were *Cauletella manica* (De Wever et Caridroit), *Ishigaum* sp. cf. *I. trifustis* De Wever et Caridroit, *Ishigaum* sp. cf. *I. obesum* De Wever et Caridroit, *Raciditor* sp., *Stigmosphaerostylus* sp. and others.

The age of the Higashimata Complex can thus be determined by the co-occurrence of the above radiolarian fossils, and indicate the late Middle to Late Permian Period (Umeda, 1986; Umeda and Hattori, 1987; Umeda *et al*., 1996; Nakae, 2011).

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西南日本，福井県南条山地におけるペルム系東俣コンプレックスの地質

中江　訓

要　旨

福井県の南条山地北縁部に分布する超丹波帯東俣（ひがしまた）コンプレックスについて，岩相・層序・地質構造・地質時代について記載した．東俣コンプレックスは，千枚岩質泥岩と砂岩などの陸源砕屑岩を主体とし少量の珪質泥岩・珪長質凝灰岩・チャートを伴う．下限は低角断層により下位の美濃帯ジュラ系と接し，上限は白亜系足羽（あすわ）層群に不整合で覆われる．全層厚は約 5,200 m に達する．東俣コンプレックスは千枚岩質泥岩・砂岩泥岩互層・砂岩が累重する層序で構成され，これが複数繰り返し露出する特徴をもつ．主要な大構造は，東西走向・北傾斜の同斜構造である．産出報告された放散虫化石に基づくと東俣コンプレックスの地質時代は，中期ペルム紀の末期から後期ペルム紀の前半と判断される．

難読・重要地名等：

Higashimata：東俣，Asuwa：足羽，Omodani：面谷，Nyū：丹生，Nishitani：西谷，Itoo：糸生，Yoshinosegawa：吉野瀬川，Akyū：秋生，Nanjō：南条，Etsumi：越美，Nosaka：野坂，Minamiechizen：南越前，Imajō：今庄，Makidani：牧谷，Shizuhara：志津原，Uomi：魚見，Ultra-Tamba：超丹波，Mino：美濃