

# *Macroscaphites* (Ammonoidea) in the Argille Scagliose Formation of Prignano sulla Secchia (Modena, Italy)

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**Abstract.** A new ammonite found in the “Argille Varicolori di Cassio” (Argille Scagliose Formation, teleallochthonous Ligurides) of Prignano sulla Secchia, in Northern Apennines (Modena, Italy), is reported. The Argille Scagliose is a formation in which ammonites are practically absent. This is the first ammonite described found in the Modena region: an incomplete but exceptionally well-preserved specimen, which is taxonomically interpreted as a juvenile *Macroscaphites* cf. *tirolensis* Uhlig, 1888. The new finding allows dating the part of Argille Scagliose named “Argille Varicolori di Cassio” of the Modena region as Early Cretaceous (Early Barremian–earliest Late Barremian), whereas this unit was formerly considered Late Cretaceous. The hiatus reported in previous studies between Argille a Palombini Unit and the overlying Argille Varicolori di Cassio Unit is therefore much shorter than previously thought.

**Keywords:** Heteromorph ammonite ▪ *Macroscaphites* cf. *tirolensis* ▪ Lower Barremian–basal Upper Barremian ▪ Argille Scagliose Formation ▪ Argille Varicolori di Cassio ▪ Prignano sulla Secchia.

**Riassunto. Ritrovamento di una ammonite eteromorfa nelle Argille Scagliose di Prignano sulla Secchia, Modena:**

Si segnala il ritrovamento di una ammonite appartenente alla specie *Macroscaphites* cf. *tirolensis* Uhlig, 1888, incompleta ma in eccezionale stato di conservazione, proveniente dalle “Argille Varicolori di Cassio” (Formazione delle Argille Scagliose, Liguridi tele-alloctone) di Prignano sulla Secchia (Modena). Nelle Argille Scagliose le ammoniti sono quasi del tutto assenti e in particolare questo è il primo ritrovamento descritto proveniente dal modenese. Le “Argille Varicolori di Cassio” erano finora considerate del Santoniano-Campaniano (Cretaceo superiore); il ritrovamento di *Macroscaphites* cf. *tirolensis* permette di datare questa porzione di successione, che si trova all'interno delle “Argille Scagliose”, al Barremiano inferiore-base del Barremiano superiore, quindi ci troviamo nella parte bassa del Cretaceo inferiore, e non nel Cretaceo superiore come erroneamente ritenuto fino ad oggi. La lacuna segnalata in letteratura tra le Argille a Palombini e la sovrastante Unità delle Argille Varicolori di Cassio (lacuna di quasi 60 milioni di anni) ora entrambe datate precisamente grazie al ritrovamento di due esemplari di ammoniti descritti da Sarti nel 2014 e nel presente lavoro è dunque molto più limitata di quanto supposto.

**Parole chiave:** Ammonite eteromorfa ▪ *Macroscaphites* cf. *tirolensis* ▪ Barremiano inferiore-base del Barremiano superiore ▪ Formazione delle Argille Scagliose ▪ Argille Varicolori di Cassio ▪ Prignano sulla Secchia.

**Resumen. *Macroscaphites* (Ammonoidea) en la Formación Argille Scagliose de Prignano sulla Secchia (Módena, Italia):** En el presente trabajo se describe un nuevo amonite descubierto en la unidad “Argille Varicolori di Cassio” (Formación Argille Scagliose, Ligurides tele-allochthonas) de Prignano sulla Secchia, en los Apenninos del Norte (Módena, Italia). En la Formación Argille Scagliose los amonites son prácticamente ausentes. El amonite descrito en este trabajo es el primero hallado en la región de Módena: un ejemplar incompleto pero excepcionalmente preservado que se interpreta taxonómicamente como un *Macroscaphites* cf. *tirolensis* Uhlig, 1888 juvenil. Este nuevo hallazgo permite la datación de la Argille Scagliose named “Argille Varicolori di Cassio” en la región de Modena como Cretácico Temprano (Barremiano Temprano-Late Barremian), en tanto esta unidad era considerada Cretácico Tardío. El hiato establecido en estudios anteriores entre la unidad Argille a Palombini y la sobreyacente unidad Argille Varicolori di Cassio es por lo tanto mucho mas breve.

**Palabras clave:** Amonite heteromorfo ▪ *Macroscaphites* cf. *tirolensis* ▪ Barremiano inferior-Barremiano superior basal ▪ Formación Argille Scagliose ▪ Argille Varicolori di Cassio ▪ Prignano sulla Secchia.

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### AMMONITE RECORDS FROM THE ARGILLE SCAGLIOSE FORMATION (NORTHERN APENNINES)

The ammonites found in the Argille Scagliose Formation (Bianconi 1840) are very rare but very important for precise dating of this unit. The first report of ammonites from the Argille Scagliose Formation was given by the famous naturalist Antonio Stoppani (1875): a specimen from Costa de Grassi, near Reggio Emilia. Two years later, two ammonite specimens were collected by Mantovani (1877) in the Argille Scagliose of Ranzano (Parma) and Monte dell'Evangelo near Scandiano (Reggio Emilia).

In his paper: "Contribution à la Connaissance paléontologique des Argiles écaillées" Federico Sacco (1893) described a fauna with ammonites, and concluded that ammonites in the Argille Scagliose are Cretaceous. Sacco (1893) described ammonites of the genera *Hamites* (4 fragmentary and poorly preserved specimens from Valle Del Dordone, one of them probably an ichnofossil), *Acanthoceras* (2 poorly preserved specimens from Cà di Panico in Val Marecchia), *Hoplites* (3 fragmentary specimens from Ranzano in Val d'Enza and Val di Taro), *Desmoceras* (2 well preserved specimens from Valle del Dordone), and *Pachydiscus* (2 ammonites).

In a second paper Sacco (1905) described ammonites assigned to the genera *Hamites*, *Scaphites*, *Toxoceras*, *Ancylloceras*, *Baculites*, *Turrilites*, *Desmoceras*, and *Acanthoceras*.

Finally, Sacco (1923) returned to the subject and reported *Hamites* from Pellegrino Parmense (Parma), and a specimen from Val Dordone (near Parma) assigned to the genus *Schloenbachia*.

Anelli (1935, 1938) collected some ammonites in the Argille Scagliose of the Emilia Apennines. Due to the poor preservation of the material, identifications were difficult. Notable is only a well preserved specimen of *Crioceras*, from Cervarezza (Reggio Emilia Apennines).

To my knowledge, later findings of ammonites were no longer reported from the Argille Scagliose. However, all these historical findings do not provide detailed stratigraphic information. This is because of the inaccurate information about the localities of provenance, and because lithological descriptions were insufficient, even for approaching a broad-stratigraphic correlation (e.g., *vide* Sacco 1905: *Acanthoceras* is Middle Cenomanian, as *Turrilites*, but *Baculites* is Upper Turonian or younger). Despite the fact that the locality data are not well-known an update of the identifications in a paper in preparation will be of much help.

Recently a very interesting specimen of *Pulchellia* (*Pulchellia*) n. sp. aff. *kiliani* Hyatt, 1903 has been described by Sarti (2014). This specimen comes from the Barremian of Argille Scagliose exposed near the East flank of Mount Montovolo (Province of Bologna), in front of the stratigraphic section Montovolo Sud, in the part of Argille Scagliose named Palombini shales (tele-allochthonous Ligurides, see Vai & Martini 2001). This specimen is the



Figure 1. A: Location of the study area. B: Topographic map of the study area with indication of the sampling point (red dot).

first ammonite described from the part of Argille Scagliose, named Palombini shales. It is indeed a very important finding because of its very good preservation and its accurate stratigraphic location. The Palombini Shales represent one of the most typical and widespread units cropping-out in the Northern Apennines, and in the Ligurid sequences (oceanic sequences) these are part of the ophiolite sequence sedimentary cover (Cobianchi & Villa 1992).

The finding of the ammonite *Macroscoaphites* cf. *tirolensis* Uhlig, 1888 described in the present paper, is very important because of its accurate stratigraphic position. This ammonite indicates a stratigraphic position in the interval Lower Barremian to base of the Upper Barremian, making possible for the first time to date by an ammonite the part of the Argille Scagliose of the Emilian Apennines named “Argille Varicolori di Cassio” (Fig. 1).

### STRATIGRAPHIC FRAMEWORK

The ammonite described in this paper was discovered by the collector Giovanni Andreoli in the Argille Scagliose Fm of Prignano sulla Secchia (Modena), in the Caselletta Quarry, where it is mainly exploited by reddish clays materials for ceramic and brick industry in the “Argille rosse della Val Rossenna”. The clays are mined from blocks embedded in the Argille Varicolori (MVRb of the Geological Map of Italy, Gasperi et al. 2005). There are also clays that are being mined in the “Argille Varicolori di Cassio” Unit (AVV) that certainly look very similar to the “Argille rosse della Val Rossenna”, and they could be confused. However, their ages are very different, the former is Cenozoic, while the Argille Varicolori di Cassio is Mesozoic. In fact, regarding the Argille rosse della Val Rossenna Unit, it is worth to note that the age is Eocene, perhaps Maastrichtian the base of the Unit MVRb (Gasperi et al. 2005). The present ammonite discovered in the Caselletta Quarry suggests that the “Argille rosse” could be attributed at least partially to the “Argille Varicolori di Cassio”, that is a Cretaceous Unit whose lower boundary is the Argille a Palombini.



**Figure 2.** *Macroscoaphites* cf. *tirolensis* Uhlig, 1888, Argille Varicolori di Cassio of the Argille Scagliose Formation, teleallochthonous Ligurides. Caselletta Quarry, Prignano sulla Secchia (Modena, Italy), Lower Barremian-basal Upper Barremian. – Double size. The scale bar represents 10 mm.

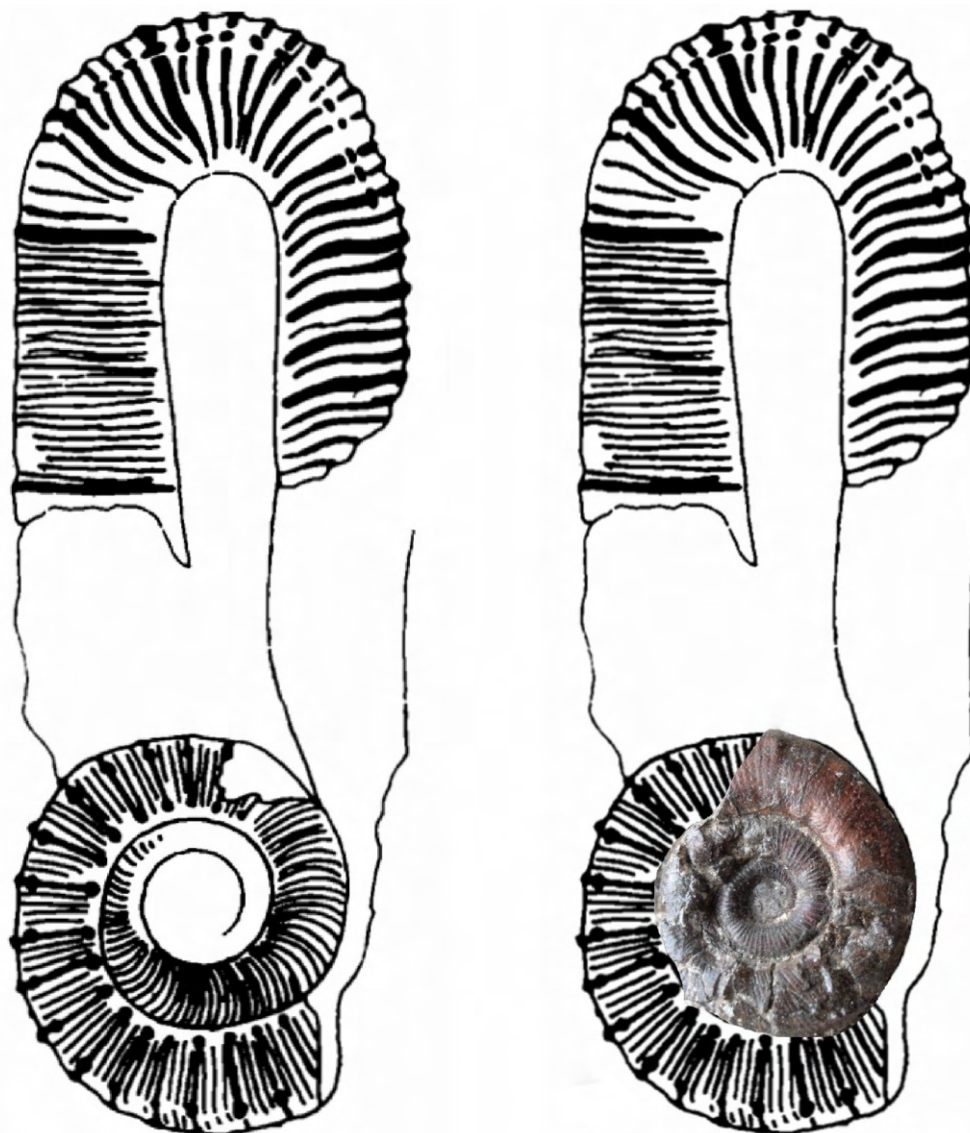
The thickness of the Argille Varicolori di Cassio is about 200 meters. On the basis of published data (Rio & Villa 1987, Gasperi et al. 2005, Serpagli 2005, Barbero et al. 2017, Serafini et al. 2019, among others) the unit ranges from the Santonian up to the Campanian. This is suggested by the analyses of microfossil associations that are attributed to the Campanian with doubts, and from ichnofossils and macrofossils (mostly Gastropoda, Lamellibranchia and Ichthyosaurs) which are poorly significant for stratigraphic purposes. Considering the present specimen of *Macroscoaphites* cf. *tirolensis*, the age of the Argille Varicolori di Cassio is now fixed as Early Cretaceous, not Late Cretaceous as previously reported by former authors. The known chronostratigraphic range of *Macroscoaphites tirolensis* is the interval Early Barremian-basal Late Barremian.

The hiatus reported in previous studies between the Argille a Palombini Unit and the overlying Argille Varicolori di Cassio Unit (about 60 million of years!), is much reduced after the ammonite record of Sarti (2014) and that of the present paper.

**Table 1.** Measurements (in mm) of the studied and comparative specimens. Abbreviations: *D*: shell diameter, *H*: whorl height, *U*: umbilical diameter, *W*: whorl width, *N*: ribs: number of primary ribs per whorl, *N/2*: number of primary ribs per half whorl.

	<i>D</i>	<i>H</i>	<i>U</i>	<i>W</i>	<i>H/D</i>	<i>U/D</i>	<i>W/D</i>	<i>N</i> :ribs
<i>Macroscoaphites</i> cf. <i>tirolensis</i> (Fig. 2)	26.4	8.4	12.0	~7.0	0.32	0.45	~0.26	99-100
	20.4	6.3	8.8	-	0.31	0.40	-	84-85
	14.0	5.3	6.0	~5.5	0.38	0.43	~0.39	~ 70
	12.0	3.6	4.8	-	0.30	0.40	-	62-63
	10.5	3.1	4.5	-	0.30	0.43	-	52-53
<i>Macroscoaphites tirolensis</i> (Holotype)	33.0	10.0	17.0	~6.0	0.30	0.51	0.18	99-100
	26.0	7.0	13.0	-	0.27	0.50	-	80-81
<i>Macroscoaphites yvani</i> (Holotype)	55.5	13.8	30.1	12.0	0.25	0.54	0.22	84
	41.9	11.8	22.6	-	0.28	0.54	-	82
	~ 26	~ 7.5	~ 13	-	~0.29	~0.5	-	~ 68
<i>Macroscoaphites yvani</i> (Baudoin et al. 2012: 632; crn60)	49.3	14.1	24.0	-	0.29	0.49	-	47 (N/2)
	42.3	13.4	19.7	-	0.32	0.47	0.37	49 (N/2)
	37.9	12.6	17.2	-	0.33	0.45	0.38	50 (N/2)
	31.3	10.7	14.2	-	0.34	0.45	0.41	-
	25.4	7.3	12.3	-	0.29	0.48	0.45	-
	19.4	5.2	8.5	-	0.27	0.44	-	-





**Figure 3.** A: Sketch (modified) from Avram (1984: fig. 8b) of the holotype of *Macroscaphites tirolensis*. B: The specimen of *Macroscaphites* cf. *tirolensis* described in the present paper (slightly reduced), superimposed on the sketch A for comparison.

#### SYSTEMATIC PALAEOLOGY

The specimen described was donated by Giovanni Andreoli to the Museum of Ecology and Natural History of Marano sul Panaro (Modena): inventory number 901/GF.

**Superfamily Ancyloceratoidea Gill, 1871**

**Family Macroscaphitidae Hyatt, 1900**

**Genus *Macroscaphites* Meek, 1876**

**Type species.** *Scaphites yvani* Puzos, 1832; subsequent designation by Roman (1938: 38).

**Remarks.** Since Munier-Chalmas (1892) *Macroscaphites* and *Costidiscus* Uhlig, 1882 are considered possible dimorphic partners (Avram 1984). Among the Barremian species of *Macroscaphites* and *Costidiscus* a few constitute surely dimorphic pairs, controlled by the accurate recording, bed by bed, of the material, e.g. *Macroscaphites yvani* and *Costidiscus recticostatus* (d'Orbigny, 1841), see Baudouin et al. (2012). Some other species were grouped in

dimorphic pairs with doubts and others have not presumable partners currently. This is the case of the microconchiate *M. tirolensis*.

***Macroscaphites* cf. *tirolensis* Uhlig, 1888**

Figs. 2-4

cf. 1888 *Macroscaphites tirolensis* n. sp. – Uhlig: 86, pl. 4: 2.

cf. 1920 *Macroscaphites tirolensis* Uhlig. – Gignoux: 117.

cf. 1972 *Macroscaphites?* *tirolensis* Uhlig. – Vasicek: 48, pl. 3: 2.

cf. 1984 *Macroscaphites tirolensis* Uhlig. – Avram: 73, fig. 8b.

**Material.** One specimen with inventory number 901/GF.

**Locality of provenance.** Caselletta Quarry, Prignano sulla Secchia (Modena, Italy).

**Stratigraphic location.** “Argille Varicolori di Cassio” (Argille Scagliose Fm, tele-allochthonous Ligurides).

**Description.** Small, very evolute microconch (maximum diameter about 26.5 mm), planispirally coiled with slightly covering whorls, with broad and shallow umbilicus and gentle, low umbilical wall. Whorl section slightly depressed-oval, whorl width-to-high ratio ( $W/H$ ) = 1.03 at 14 mm diameter ( $D$ ), becoming subcircular ( $W/H$  = 0.95 at  $D$  = 26 mm) with venter slightly convex. Ornamentation consists of dense straight and radial ribs in the inner whorls, becoming slightly prorsiradiate on the outer half-whorl. Ribs mainly simple, very rarely bifurcated at mid-flank. The ribbing is not uniform, increasing in density through the ontogeny: 52-53 ribs per whorl at  $D$  = 10.5 mm diameter, 70 at  $D$  = 14 mm, to 99-100 at  $D$  = 26.4 mm. The ribs are well marked and sharp on the inner whorls, but weaker and rounded in the last whorl, and crossing the venter apparently uninterrupted. On the last preserved part the shell shows two rows of nodes, one close to the umbilicus and the second at the transition of the flanks to the venter. At the diameters of approximately 26 mm, 25 mm and 24.6 mm, three ribs show tubercles elongated, small at the transition of umbilicus to flanks, and more prominent at the transition of the flanks to the venter. These are well marked, forming ventro-lateral claviform nodes slightly prorsiradiate, and after they broaden out, forming three slightly thicker and more evident ribs on the venter. One rib, slightly more pronounced, with tubercles occurs between 3 to 4 simple ribs. Only one constriction occurs in the inner whorls ( $D$  = 9 mm). The constriction is narrow and parallel to the ribs. The specimen preserves only the spiral whorls of the phragmocone. The typical straight or curved shaft and recurved crozier body chamber is not preserved (Fig. 3).

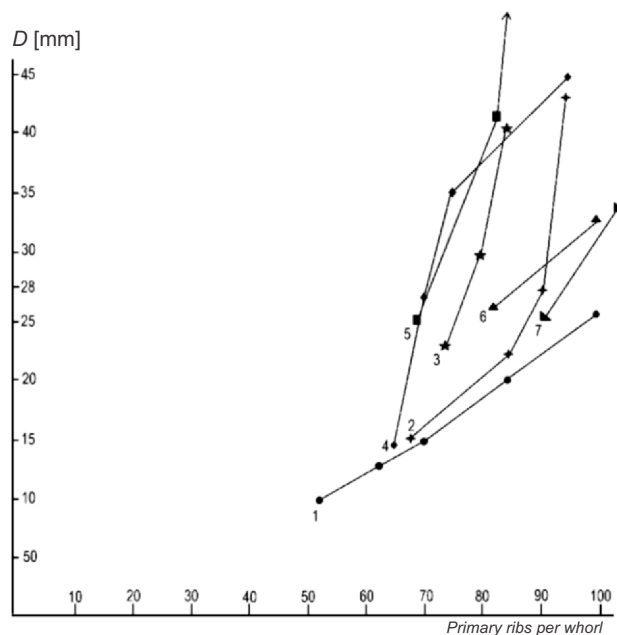
**Discussion.** It is not possible to make an exact specific assignment of the ammonite because the final part of the coiled and the entire uncoiled part are not preserved. The specimen matches the morphological characteristics of the species *Macroscephites tirolensis* Uhlig, 1888 but with slight differences with the holotype: narrower umbilicus, greater whorl width, and partly whorl height, and, moreover shows a lower numbers of ribs.

It differs from *Macroscephites binodosus* Uhlig, 1883 by the slightly smaller size and more prominent ribs. Tubercles or nodes are elongated in the present species but rounded in *M. binodosus*.

*Macroscephites olcostephanoides* (Uhlig, 1883) differs from *M. tirolensis* by its ribs forming bullae only on the umbilical border, and bifurcating in the inner whorls, as well as by its more involute coiling.

*M. yvani* differs from *M. tirolensis* by the complete lack of tubercles through the ontogeny; our specimen bears small umbilical nodes and well marked ventro-lateral claviform tubercles on the last preserved part of the shell. Furthermore, the relative umbilical width is larger in the holotype of *M. yvani*. Another difference of our specimen with respect to *M. yvani* is the lower number of ribs at comparable diameter (Fig. 4). A species similar to *M. yvani* is *Macroscephites striatissulcatus* (d'Orbigny, 1841) which differs from *M. tirolensis* by its much more frequent bifurcate ribs and more frequent constrictions.

**Stratigraphic distribution.** *M. tirolensis* is recorded only in the Barremian (see Vasicek 1972) and has been mentioned with accurate stratigraphical position from the



**Figure 4.** *Macroscephites* cf. *tirolensis* Uhlig, 1888. Primary rib-density curves of the specimen described in this paper and species discussed in text. (1) *Macroscephites* cf. *tirolensis* Uhlig, 1888; (2) *Macroscephites yvani* (Puzos, 1832) in Baudouin et al. (2012: pl. 9: 1); (3) *Macroscephites yvani* (Puzos, 1832) in Baudouin et al. (2012: pl. 9: 3); (4) *Macroscephites yvani* (Puzos, 1832) in Baudouin et al. (2012: pl. 9: 2); (5) *Macroscephites yvani* (Puzos, 1832), holotype; (6) *Macroscephites tirolensis* Uhlig, 1888, holotype; (7) *Macroscephites binodosus* Uhlig, 1883, holotype.

lower Barremian, base of the Moutonianum Zone (corresponding to the base of the Darsi Zone) in the Puez area, South Tyrol, North Italy (Lukeneder & Lukeneder 2014), middle-upper parts of the Darsi Zone (Vermeulen 1997, 1999) and base of the upper Barremian in the Carpathian area (Avram 1983).

## CONCLUSIONS

Known fossils from the Argille Scagliose Formation are very rare, including ammonites. The few references found in literature are almost all from the mid 19<sup>th</sup> to the early 20<sup>th</sup> century. The recently described *Pulchellia* n. sp. aff. *kiliani* is remarkable by the accurate stratigraphic location of the specimen (Sarti 2014). The relevance of the finding of the exceptionally well preserved specimen of *Macroscephites* cf. *tirolensis* described in the present paper, is remarkable by its stratigraphic location, allowing a new understanding on the chronostratigraphic position as Lower Barremian-basal Upper Barremian that, for the first time with an ammonite, makes it possible to date the part of the Argille Scagliose of the Emilian Apennines named “Argille Varicolori di Cassio”.

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