

# Science and human society

## Granites and Metal deposits

### 1. What is granite?

Controversy on origin of granites

### 2. Granite classification

### 3. Granitoids series and mineralization

- There have been repeated controversies on the origin of granites
- Granites are classified two series, magnetite series and ilmenite series by present or no of magnetite
- Molybdenum deposits are dominant in magnetite series, while Tungsten deposits are dominant in ilmenite series

# What is granite?

A visibly crystalline plutonic rock with granular texture; composed of quartz and alkali feldspar with subordinate plagioclase and biotite and hornblende.



## Neptunists and Plutonists, a controversy in late 18 c

- Neptunists believed that granites – along with all rocks – were precipitated from the oceans.

According to the Neptunists, the granitic layer of the Earth was the old layer, upon which younger fossil-bearing layers were deposited.

Supporters: Abraham Werner, Johann Wolfgang von Goethe

- Plutonists posited that plutonic rocks had their origin in fire and were crystallized from magmas.

Supporters: Anton Moro, James Hutton

# Dykes

Ultimately, it was the recognition of dikes (tabular bodies of rock crosscut older rocks) that vanquished the Neptunists. Plutonists successfully argued that these rocks could not have been deposited from the sea.



# Bowen's Reaction Series

Ca-plagioclase → Na-plagioclase ↘

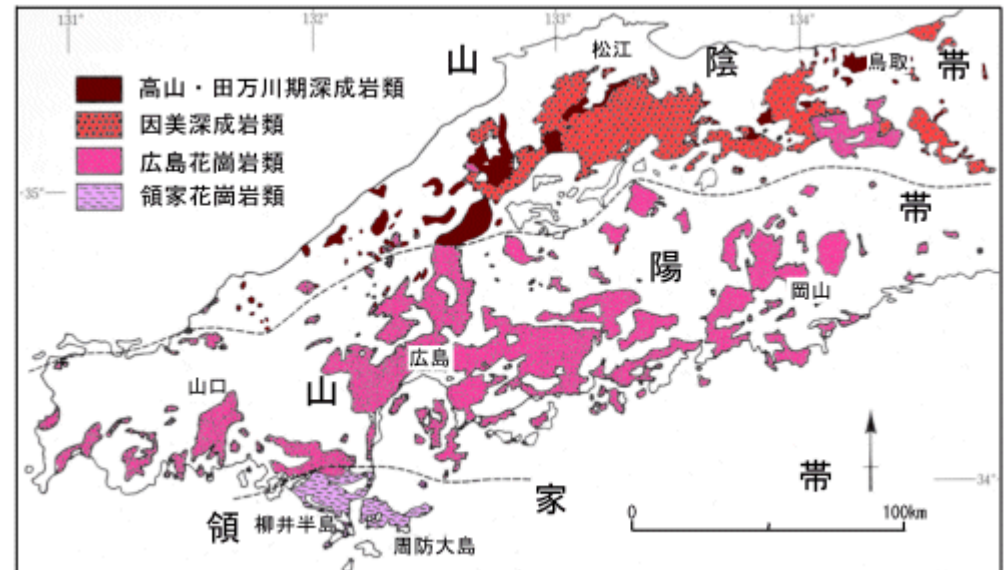
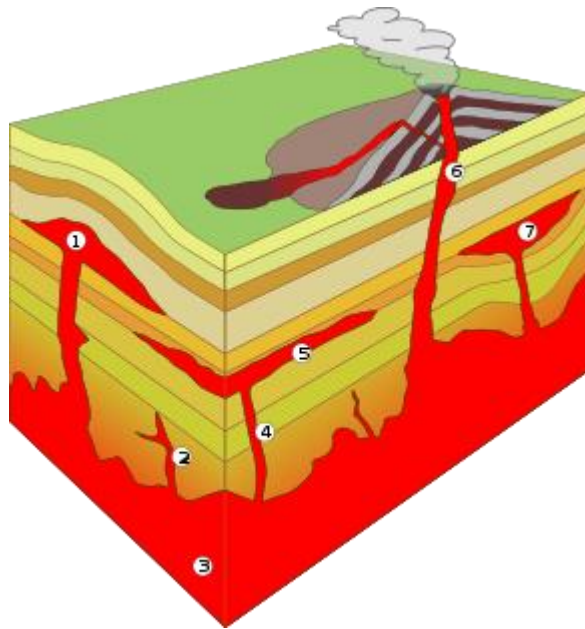
K-feldspar, Quartz

Olivine → Amphibole → Biotite ↗

As a result, magma changes in order of Basalt → Andesite → Rhyolite (Granite).

# Room problem

If granites intrude as magmas, how are the wall rocks displaced in order to make space for the granite?



中国地方における白亜紀～古第三紀深成岩類の分布 『日本の地質7 中国地方』 猪木・村上・大久保ほか (1987) 古今書院



# Stopping, Magmatic stopping



A process of igneous intrusion in which magma gradually works its way upward by breaking off and engulfing blocks of the country rocks.



## Summary of granite controversy

Late 18 century Neptunists and Plutonists

The Plutonists vanquished the Neptunists by recognition of dikes.

Early 20 century Crystallization differentiation from basaltic magma

How to explain huge volume of granitic intrusion –Room problem

Middle 20 century Granitization –Metasomatic mechanism

A melt-dominated mechanism or a metasomatic mechanism

Modern debate

How do plutonic magmas accumulate? What events are dated in the life and death cycle of a pluton? How are ages interpreted?

End of 20 century Amalgamation of many dikes and/or sills

## Granitoids series

The greatest contribution to the granite petrology during the last quarter of 20th century would be the proposition of the granitoids series: magnetite-series, ilmenite-series, I-type, M-type and A-type. Australia and Japanese geologists have played an important role on the establishment of the granitoids series.

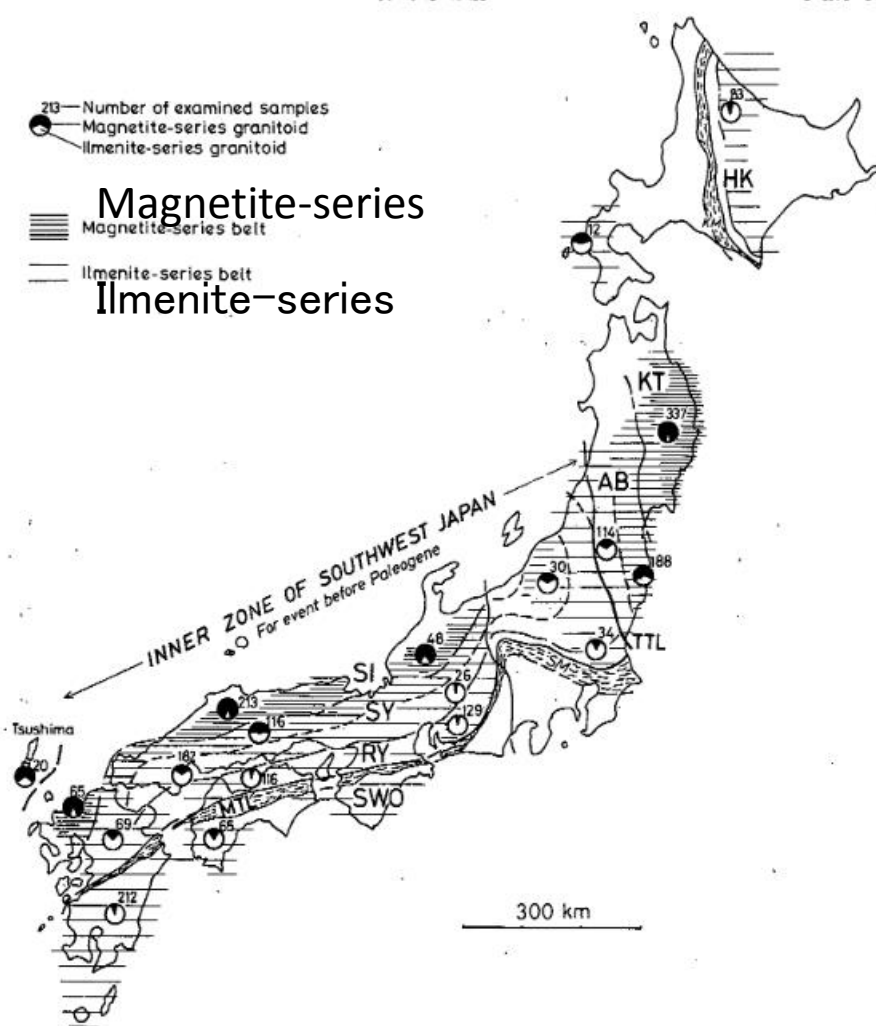
Alphabetical classification (Chappell & White, Australian)

I-type: Occurrence of Ca-bearing mafic minerals such as hornblende and rich in Ca.

S-type: Presence of aluminous minerals such as cordierite, garnet,  $Al_2SiO_5$  minerals and muscovite, and rich in K and Al and poor in Ca and Na.

The magnetite-series granitoids are characterized by the presence of magnetite. The ilmenite-series granitoids are characterized by magnetite free. In Southwest Japan, the ilmenite-series rocks are dominant in Ryoke and Sanyo belts and the magnetite-series rocks are dominant in San-in belt.

## Granitoids series by Ishihara



Molybdenum (Mo) deposits are dominant in San-in belt (magnetite series granite) and Tungsten (W) deposits are in Sanyo belt (ilmenite series granite), south-west Japan.



Figure is cited from Ishihara (2002). Mining is now abandoned.

Molybdenum in manufacturing  
Molybdenum is mechanically strong.  
Molybdenum is mainly used special steel.

Tungsten in manufacturing  
Tungsten is very hard.  
Tungsten is used an ultra-hard blade. It is important in manufacturing for automobiles.

# Videos and a text are introduced.

Some movies

Valley of granitic rocks (NHK,2000),2min 23sec

[https://www2.nhk.or.jp/archives/michi/cgi/detail.cgi?dasID=D0004500077\\_00000](https://www2.nhk.or.jp/archives/michi/cgi/detail.cgi?dasID=D0004500077_00000)

Stellite, Alloy of Co with Cr and W,1 min 7sec

[https://www.youtube.com/watch?v=IA5s7x3KG7E&feature=emb\\_logo](https://www.youtube.com/watch?v=IA5s7x3KG7E&feature=emb_logo)

Text

Fore more deep understanding granites

[http://y95480.g1.xrea.com/granite\\_takahashinote.pdf](http://y95480.g1.xrea.com/granite_takahashinote.pdf)