IBM Magmatic System

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IBM Arc System:
2800 km long

3 segments from N to S:
Izu
Bonin/Ogasawara/Volcano
Mariana
Perspective Views of the IBM Subduction Zone
(Colored depth contours every 100 km)

Chiu et al., 1991
Four Outputs from IBM

- Forearc fluid outputs (Fryer, tomorrow)
- Magmatic Outputs
  - Magmatic Front
  - Cross-Chains
  - Extension-related
- Magmatic Outputs
  - Magmatic Front
  - Cross-Chains
  - Extension-related
  Izu rifts
  Mariana Trough
Active IBM Arc is subdivided into 3 segments based on Chemistry:

- Izu-Bonin
- Shoshonitic Province
- Mariana
Mean Compositions of 62 volcanoes of the IBM Magmatic Front
No obvious difference
In depth to Wadati-Benioff Zone beneath IBM arc magmatic front.

Abers, pers. com., 2001
Arc magmatic systems are complex

And that’s just in the crust!

Please note: the next slide contains a large animated GIF file. Skip to slide #11 if you do not wish to download the 1.5 MB image.
Arc magmatic systems are complex

And that’s just in the crust!
IBM arc Lavas have characteristic Trace Element patterns

Depletions in Nb, Ta; Enrichments in Rb, Ba, U, K, Pb, and Sr
IBM Magmatic Arc consists of Three Island Groups And lots of submarine volcanoes

Tour Magmatic Arc from south to north
Mariana Southern Seamount Province
Guguan
N. Pagan Volcano (570m)

S. Pagan (548m)
Extinct
**Agrigan (965m, erupted 1917)**

**Cumulate xenolith**
Maug: Extinct caldera
Uracas - Farallon de Pajaros - ‘Lighthouse of the Pacific’

Northern terminus of Mariana Islands
Kasuga Cross-Chain

Hussong & Fryer, 1983
Shoshonitic Province

Minami Iwo Jima

Eruption of Jan. 1986 (courtesy Hydrographic and Oceanographic Department of Japan)
Motoyama is a broad tuff dome.

The last eruption on Motoyama: $^{14}$C age = 2600±80 years ago.

Iwo Jima (Sulphur Island)

Suribachi

Motoyama
Origin of Enrichments in Shoshonites: Enriched Mantle or Subducted Sediments?
Izu Arc
Torishima
First eruption in 63 years started Aug. 12, 2002
1902 eruption killed all 125 residents.
Myojin Knoll caldera (rhyodacite)

Sunrise Deposit
(400*400*30M)

20 ppm Au  1200 ppm Ag  5.5%Cu  22% Zn  2% Pb
(Iizasa et al., 1999 Science)
Hachijojima
(famous for banishment)

New Energy and Industrial Technology Development
Drill site

Photo by K. Suga
Higashiyama cored to 1500m

Hawaii Sci. Drilling Project

Now at 3.1 km, aiming for 4.5 km, maybe go to 6 km

Hirata et al., 1997
Hachijojima
Seismic swarm
August 2002
Mikurajima
Miyakejima
14 historic eruptions
Erupting sporadically since 2000

SeaWIFS 2/22/01

ASTER 7/00  ASTER 9/00

1983 flow buried Ako village
SO₂ flux measured by GSJ with COSPEC 2 for 8/00 to 8/02.

- Flux allows magma degassing rate to be calculated from S content of the magma (1500-2000 ppm melt inclusion, EPMA). Peak SO₂ flux of 40 kt/d at end of 2000 indicates 10 Mt of magma degassed per day (from GSJ website http://staff.aist.go.jp/kazahaya-k/miyakegas/COSPEC.html).
SO₂ flux is controlled by:

a) bubble separation rate from magma
b) magma convection rate (mass flow rate of undegassed magma)

From GSJ website: http://staff.aist.go.jp/kazahaya-k/miyakegas/COSPEC.html
Northernmost IBM is very magmatically active. Includes large VF volcano of Oshima and associated cross-chain. Fuji and Hakone.
Relatively large eruptions every 150 years, Smaller eruptions, like 1986, every 35 years.

1986 Eruption of Miharayama
Seismic experiment at Izu-Oshima Volcano 27 October - 5 November 1999, intended to clarify the subsurface structure of the volcano, including the location of magma reservoir, and to understand the magma plumbing. Survey lines and 2-dimensional arrays cover about 160 and 60 seismometers, respectively.
Izu Cross-Chain

Nii Jima

Kozushima Ignimbrite

Photographs by K. Suga

Graph showing the distribution of different rock types with respect to their silica (SiO2) and K2O contents.
Hakone is an active volcano 30 km SE of Fujiyama. Hakone Volcano has a 10 km-diameter caldera. The latest eruption took place ca. 3,000 B.P.
Fujiyama - the Magmatic terminus of IBM

Modern Fuji is 11,000 years old.