

Eruptive history of Tianchi Volcano, Changbaishan, northeast China: Process and hazard

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Tianchi volcano, also known as Changbaishan or Baitoushan volcano, on the China-North Korea border is a historically active polygenetic central volcano, which consists of three parts: a lower basaltic shield, an upper trachytic (and comendite) composite cone, and young comendite ignimbrite flows as shown in the table. The Millennium Eruption occurred between 938 and 946 AD. There have been some additional, small "historical" eruptions in the last three centuries.

Between 2002 and 2005, unrest signals including seismicity, deformation, and the helium and hydrogen gas contents of spring waters increased markedly, causing a regional concern. We attribute this unrest event to magma recharge or volatile exhalation or both at depth, followed by two episodes of addition of magmatic fluids into the overlying aquifer without a phreatic eruption. The estimated present magma accumulation rate is rather low to account for the 2002-05 unrest but there are some indications for magma mixing process happened beneath the volcano in the past. The most serious volcanic hazards near Tianchi Volcano are related to ignimbrite-forming eruptions and lahars.

Stages; Formation and Age; Lithologies

Historical or post-ignimbrite eruptions;

Liuhaojie tuff ring (1903 AD?); Comendite phenomagmatic layers

Wuhaojie (1702 AD?); White gray comendite fine glass ash

Baguamiao (1668 AD?); Dark gray trachyte ignimbrite and pumice

Late: Ignimbrite-forming;

Millennium eruption (946-939 AD); White gray comendite ignimbrite and air fall pumice and B-Tm ash with minor trachyte ignimbrite and air fall pumice

Qixiangzhan (17 Ka); Comendite lava and pyroclasts

Tianwenfeng falls (25 Ka); Yellowish fallouts on the rim and B-V tephra layer

Middle: Composite cone construction;

Baitoushan 3 (0.02-0.22 Ma); Trachyte and comendite lava

Baitoushan 2 (0.25-0.44 Ma); Trachyte with Laohudong basalt

Baitoushan 1 (0.53-0.61 Ma); Trachyte

Laofangzixiaoshan (0.75-1.17 Ma) Basalt

Xiaobaishan (1-1.49 Ma); Trachyandesite and trachyte

Early: Shield-forming;

Baishan (1.48-1.66 Ma); Basalt

Toudao (2.35-5.02 Ma); Basalt

Naitoushan (15.6-22.64 Ma); Basanite, Basalt