Manchester Geological Association

Saturday 12th December 2009 – Volcanoes and Volcanic Hazards

13.30 – 14.15 Diverse Volcanism of the Western Pacific Ocean Floor
Dr. Peter Floyd, University of Keele
14.15 – 15.00 Volcano-Ice Interactions in Iceland – Dr. Dave McGarvie, Open University

15.00 – 15.30 Coffee Break

15.30 – 16.15 Improving the Monitoring at Volcan de Colima, Mexico
Dr. John Stevenson, University of Manchester

Volcanoes can be broadly classified into three groups based on their tectonic setting: - those formed at constructive plate margins, at destructive plate margins, or within plates. The greatest outpouring of magma, mainly basaltic, takes place at ocean ridges (constructive margins), but this is mostly extruded as lava, not in the form of volcanic cones - an exception being Iceland.

The majority of volcanoes form above subduction zones at destructive margins. Volcanic island arcs (for instance, the Aleutian Islands in the Pacific or the Lesser Antilles in the Caribbean) form where subduction of oceanic crust is taking place under oceanic crust. These consist of basalts and andesites, rarely dacites and rhyolites. Continental arcs (e.g. the western coast of the Americas – North, Central and South) form where subduction of oceanic crust is taking place under continental crust. These are predominantly andesites, but with more silicic rocks - dacites and rhyolites – than those seen in island arcs.

Other volcanoes occur within oceanic or continental plates (for example, the Hawaiian Islands, on oceanic crust, or the Auvergne of France and the Eifel region of Germany, on continental crust). These are attributed to hot-spots caused by mantle plumes – columns of heat rising from the core-mantle boundary. These tend to be more silicic and alkaline, often containing phonolites and trachytes.

Diverse Volcanism of the Western Pacific Ocean Floor
Dr. Peter Floyd, University of Keele

The lecture provides a summary and evaluation of Jurassic and Cretaceous submarine volcanic activity as obtained from solid cores of various Legs of scientific ocean drilling (DSDP and ODP) in the western Pacific. Two aspects will be considered: (a) the hunt for the oldest existing ocean crust (Jurassic) in the western Pacific Ocean and (b) the diversity and source of submarine volcanism during the early and middle Cretaceous.

After a number of failed attempts Middle Jurassic ocean crust (167 Ma) was finally drilled during Leg 129; one objective was to discover the nature of the ocean crust currently being subducted under the Mariana island arc. There were also a few additional surprises, such as a 157 Ma alkali basalt seamount and an Fe-Si low-temperature hydrothermal deposit.

The early and middle Cretaceous was a very active period of earth history, with extensive synchronous submarine volcanism, development of large ocean plateaux, rapid seafloor spreading and climate change, largely during the Normal Polarity of the Cretaceous superchron. Drilling and seismic surveys in the Naura, East Mariana and Pigetta Basins demonstrated the development of extensive basalt sheet flows and sills that ranged in age from ca.120-110 Ma. Synchronous with this activity were numerous submarine volcanoes (seamounts) that culminated with near-subaerial edifices with fringing reefs at about 110 Ma. Subsequently they subsided to a depth of 5-6 km while shedding turbidity flows of hyaloclastites and reefal debris into the adjacent basins. Around 122 Ma giant oceanic plateaux (the oceanic equivalent of continental flood basalts), such as the Ontong Java plateau, were also developed.

Geochemical diversity and similarities are illustrated between the different expressions of Cretaceous volcanism and a model proposed for the massive outpouring of submarine basaltic products during this time.

Volcano-Ice Interactions in Iceland
Dr. Dave McGarvie, The Open University

A fortuitous combination of high latitude plus a regular supply of erupting basalt and rhyolite means Iceland is the best place on the planet to study volcano-ice interactions.

Sustained and localised eruptions into thick ice sheets produce steep-sided edifices called tuyas. Pronounced vertical growth (up to 1500 m) is a consequence of confinement by ice, as the volcanic pile uses less energy to grow vertically. Fissure eruptions into ice sheets produce the long, linear ridges which are such distinctive features of the Icelandic landscape.

Although broad similarities exist between the products of Icelandic rhyolitic and basaltic eruptions – key differences exist that provide insight into the complexities of volcano-ice interactions. These will be explored and illustrated.

At stratovolcanoes, effusive rhyolite eruptions produce ridge-forming and perched lava flows. Ridge-forming lavas flow within ice-walled canyons melted into ridge crests, where the ice is thinnest and lava pathways are easiest to melt. Perched lavas travel along the wall-ice junctions of valley glaciers. When the ice melts they are left ‘perched’ on valley walls.

Finally, studies that combine physical volcanology, geochemistry, and Ar-Ar dating are gradually revealing the pattern of Icelandic rhyolitic volcano-ice interactions during the Pleistocene, with some surprising results.

Improving the Monitoring at Volcan de Colima, Mexico
Dr. John Stevenson, University of Manchester

Volcân de Colima has been persistently active since 1998, erupting either effusively to produce lava flows and domes, or explosively with the generation of ash columns and pyroclastic flows. Numerous larger events have resulted in evacuations of the nearby communities. Following a series of powerful explosions in 2005, the level of monitoring was increased and the existing instruments (seismometers, COSPEC) were supplemented by newer technologies (infrared camera, infrasound sensors). This presentation describes the installation of, and preliminary results from, these new instruments. Set in the context of the geology, the hazards and the local population it gives a portrait of the volcano during 2006 and 2007