Dating moraine soils to trace glacier retreat by 137Cs and 210Pbex in Hailuogou Valley (Mt. Gongga, China)

Xinbao Zhang (1), Ana Navas (2), and Jiacun Chen (1)

(1) Chengdu Institute of Mountain Hazards and Environment, CAS,China, Soil conservation, Chengdu, China (zxbao@imde.ac.cn), (2) Estación Experimental de Aula Dei, Spanish National Research Council (EEAD-CSIC), Zaragoza.Spain

The Hengduan Mountain Range lies at Southeastern Tibet. One prominent peak in this range is Mt. Gongga (7556 m a.s.l.) with a glacier area extending over 255 km2. The Hailuogou Glacier with a length of 13.1 km is the largest. In the last years the glacier is retreating faster than in previous periods of past centuries. From 1990 to 2004 the glacier retreated at an average speed of 19.6 myr-1 in relation to a rise in annual mean temperature of 0.49o C at 3000 m a.s.l during this period. The vertical vegetation belts vary from subtropical plant below 1600 m to Alpine cold meadow above 4200 m. The absence of lakes in the Hailuogou valley hinders the use of lake cores for reconstructing the dynamic of glacier retreat by the classical method of dating sediment records. However, a well documented sequence of moraines left after glacier retreat from 1823 to 2006 offer a great potential to use instead moraine deposits for dating glacier retreat. To this purpose we selected a set of moraines expanding from 1910 to 1990 over a glacial retreat length of 1750 m in the valley. In May-June 2016 sampling of soils formed on fine sediments at the 9 stable moraine sites was undertaken. A total of 9 sectioned profiles were sampled up to 10 cm at depth intervals of 1 cm. Analyses of grain size and fallout radionuclides 137Cs and 210Pbex were done in the 90 interval samples.

The soils at the three oldest moraine sites of 1910, 1915 and 1930 under mature subalpine forest had the highest 137Cs inventories of 818.9 Bqm-2, 764.7 Bqm-2 and 891.2 Bqm-2, respectively, with a mean value of 824.9 Bqm-2. The 137Cs inventory declines to 588.2 Bqm-2 at the 1945 moraine and to 105.2 Bqm-2 at the 1972 moraine and then it was very low due to erosion and the limited amount of 137Cs fallout. The 210Pbex inventory of 10718.9 Bqm-2 was the highest at the 1910 moraine and it declined with time being 3669.6 Bqm-2 at the 1990 moraine site. For a non-erosion site, the moraine deposit time of less than 100 years can be derived from the local reference inventory and the inventory at the site by using the following 210Pbex fallout accumulation-decay model:

$$A = A_0 (1-a^n)$$
$$n = y_1 - y_2$$

Where, A=210Pbex inventory in soil at a moraine deposit site; A0=the regional 210Pbex reference inventory, Bqm-2; a= 0.969, 210Pb decay coefficient; y1= sampling year; and y2= moraine deposit year.

For the first time it has been possible to establish a 210Pbex dating model based on moraine deposits from glacier retreat with support of the IAEA INT/5/153 project.