

EGU2020-10414

<https://doi.org/10.5194/egusphere-egu2020-10414>

EGU General Assembly 2020

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Kaolin and quartz from extractive waste: the example of the Monte Bracco area (Piedmont, northern Italy)

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The Monte Bracco area (western Alps, northern Italy) is well known for the “Bargiolina” quartzite, a dimension stone that has been exploited in slabs at least since the XIII century, used as internal and external facing, especially in the Baroque. The quarries are located mainly on the top of the Monte Bracco, geologically pertaining to the Dora-Maira Massif, a crystalline massif of the Penninic Domain (Palaeozoic basement and a thin Mesozoic cover). The quartzites occur in sub-parallel lenses (thickness between 2 and 10 m), hosted by ortho- and paragneiss, locally strongly altered in clayey material (kaolinization). The quartzite varieties are characterized by a fine and homeoblastic grain size, a granular – lepidoblastic texture, with regular spaced schistosity, and the main rock-forming minerals are quartz (70 – 90 wt.%), phengite (up to 15 wt.%), K-feldspar (orthoclase, 5 – 10 wt.%, frequently altered in kaolinite) and traces of albite, chlorite and accessory minerals. The quarrying activity boomed between the XIX and the end of the XX century (up to 40 quarries), but the bad exploitation planning in the XX century, which involved the best portions of the rock body, led to partly exploited quarry benches, characterized by a residual yield rate of about 4-8%. At present the quarrying activity is nearly stopped due to low yield rate (and the consequent huge production of waste) and to the competition of the widespread “golden quartzite” from Brazil. The huge amount of quarry waste, the quartz-rich composition and the abundance of kaolin in the altered host gneiss suggest interesting applications as industrial minerals. Due to the high quartz content, the quarry waste (estimated in 2,250,000 m³) could be extracted as a secondary raw material and mineral dressed to obtain products for ceramics, refractories, abrasives and glass manufacturing. The recovery of the kaolinized host gneisses should also be evaluated: the deposit shows proper geochemical, mineralogical and petrographical characteristics for kaolin exploitation, which however should be programmed and carried out together with the exploitation of the quartzite deposit (which lays on the kaolinitic gneiss bench). Preliminary mineralogical and geochemical data (XRPD and XRF) show an appreciable amount of kaolin (8 – 25 wt. %, with a very low Fe₂O₃ content) in the altered gneisses, and a substantial compositional homogeneity in the different sampled areas. In addition to kaolin, the other main minerals are quartz, K-feldspar and a mixture of phengite and illite, a quite good “raw material” for the ceramic industry. The volume of the kaolinitic gneisses should be further evaluated by targeted field and geophysical surveys, followed by core drilling. In the perspective of a sustainable mining, it is important to move towards the integrated exploitation of the Monte Bracco area, contemporary mining both the

quartzite waste and the kaolinitic gneiss (first category materials, industrial minerals), as well as the quartzite benches (second category materials, dimension stone).