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Variable climate impact of metamorphic degassing of dolostone, limestone and shale in the contact aureoles in LIPs

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Analysis of the sedimentary wall rocks of several large igneous provinces has demonstrated that the release of thermogenic gases may be largely responsible for global climate change and mass extinctions (e.g. Svensen et al., 2007 ; Ganino and Arndt, 2009). Our petrological and geochemical investigation of the contact aureoles in carbonates around two large mafic intrusions provides evidence that the level of emission of carbon dioxide depends on the composition of the protolith. Aguablanca, the largest Cu-Ni-PGE deposit in Europe, formed during the Variscan Orogeny when a mafic magma intruded limestones and shales creating a contact aureole of marbles, skarns and hornfels. Panzhihua, a large Fe, Ti V deposit in SW China, formed during the emplacement of Emeishan Large Igneous Province when a gabbroic magma intruded dolostones and shales creating a contact aureole of brucite marble. We quantified carbon dioxide degassing during contact metamorphism in both cases and showed that pure limestone is relatively unproductive because of its high reaction temperature. The presence of clay leads to the formation of calc-silicates at lower temperature and enhances CO_2 degassing. The global degassing of the Aguablanca contact aureole was estimated about 37 Mt of CO_2, a low volume that we attribute to the unfertile lithology of the wall rock, which consists mainly a pure limestone. Contact metamorphism of dolostones and marls in the contact aureole of Panzhihua produced an order of magnitude more CO_2 (22 Gt). Our approach allows us to calculate the gas yield of different sedimentary lithologies and provides a tool to predict the environmental impact of the emplacement of large igneous provinces in sedimentary basins.