



Natural and anthropogenic CO₂ hazards in karstic and pseudokarstic caves

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Australian and some other speleologists have found it possible to function effectively in caves with an atmospheric CO₂ level of 6%. Further, biospeleologists have found an entire ecosystem functioning at this level and have urged others to perform similar studies. 6% CO₂ far exceeds “accepted” industrial safety standards. High concentrations of CO₂ (hypercarbia) do cause progressive respiratory distress and impaired brain function. Lowered oxygen levels associated with increased CO₂ can be lethal whereas increased CO₂ is merely distressing if adequate oxygen is present. Anthropogenic hypercarbia results from one of two mechanisms: human activity in a poorly ventilated space resulting in conversion of atmospheric oxygen to CO₂, and dumping of industrial waste into karstic or pseudokarstic aquifers. The latter is beyond the scope of this report. But physical activity in poorly ventilated spaces is a well-recognized industrial hazard, and also occurs during rescues of cavers in small spaces. As oxygen is converted to CO₂ on a volume-by-volume basis, this depletes oxygen quickly in a small, poorly ventilated area. Especially below elevations of about 1250 meters, natural addition of volcanic CO₂ into caves is much less dangerous because a much larger increase in CO₂ is required to dilute the cave’s oxygen to a dangerous level. It is important to note that governmentally-decreed industrial standards of all types (including those for CO₂) are largely irrelevant to volunteer spelean activities because they consist of political and sociological modifications of basic medical science. A large “Safety factor” is necessary to provide what workers perceive as “a safe, healthful place of employment”, especially for workers whose physical condition is unequal to that of healthy adult speleologists. In many countries, places of employment legally must meet this requirement. A large political factor additionally may be necessary to satisfy perceptions of organizations representing workers or employers,

whichever happens to be dominant at a given moment. And sometimes hidden agendas of government administrations still further distort the scientific basis of such standards. While measuring atmospheric CO₂ can be very reassuring to workers or rescue teams, measuring atmospheric oxygen generally is much more relevant in caves. This should be performed whenever there is reason to suspect hypercarbia, whether or not atmospheric CO₂ also is measured. In the presence of adequate oxygen, symptoms of mild to moderate hypercarbia can be ignored in healthy adult cavers for considerable periods of time.