Buoyant Hydraulic Fractures: How they Emerge, Grow, and get Arrested

1 Abstract

Most anthropogenic applications of hydraulic fracturing treatments are performed in sedimentary basins. In these geological formations, the minimum compressive stress is usually horizontal and increases with depth. As a result, hydraulic fractures grow along vertical planes. Because the density of the fluid and solid are generally different, a buoyant force between the hydrostatic pressure gradient and the background stress emerges, allowing for possible self-sustained buoyant propagation. The limitation of such height growth of hydraulic fractures above the formation of interest is a key metric for the design of successful hydraulic fracture treatments. We present an overview of the governing factors leading to buoyant hydraulic fracture emergence, propagation, and arrest. We notably show that the entire history of such fractures can be related to only two dimensionless numbers. We use this knowledge to study the arrest of such fractures by various possible arrest mechanisms like changes in the fracturing toughness, minimum in-situ compressive stress, and others.

2 Biography

Dr. Andreas Möri is currently a post-doc in the Geo-Energy Laboratory in the Civil Engineering Department at EPFL, studying the feasibility of fracture thermal energy storage. He holds a BS and MS degree in Civil Engineering from EPFL and obtained his PhD from the same university in September 2023. In his thesis, he studied opening mode hydraulic fractures and notably investigated the influence of gravitational forces on their propagation, emergence, and arrest.