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Axial magma chambers, hydrothermal circulation, and faulting at ocean spreading centres

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Axial magma chambers (AMC) reflections (lens) have been observed beneath fast and intermediate spreading centres, and most recently beneath a slow spreading centre. They are generally 2-4 km wide, 50-100 m thick and have a solid roof and a solid floor. If the melt in the AMC is fresh, then the AMC would have pure melt, otherwise, it would be partially molten. Given the temperature and pressure at AMC depth, it would take about 30 years to cool and crystallise a 50 m thick melt lens, which suggests that for a study state AMC to exist, there should be melt supply every 10-15 years in the AMC. The presence of the solid floor suggests that at least the upper gabbros are formed by the cooling and crystallisation of melt in the AMC. The lower crust usually contains partially molten material, and could be underlain by a well-developed Moho, suggesting that the lower gabbros are formed in the lower crust. There are some observations that suggest that melt might be present below the Moho in the upper mantle.

There seems to be a 150-200 m thick low velocity zone above the AMC roof, which could be the base of the hydrothermal circulation. The micro-earthquake activities associated with the hydrothermal activity corroborate the above interpretation. A fresh supply of melt from the mantle in the AMC leads to an enhanced hydrothermal activities. As the melt ascends and fractures the floor of the AMC, it may lead to micro-earthquake activities below the AMC. Once the melt moves from the AMC to the surface, it has to break the solid roof, which means that the micro-earthquake activities during a dyking sequence should initiate just above the AMC. The presence of faults down to the AMC depth supports the above interpretation. These faults also act a pathway for hydrothermal circulation for vents on the seafloor.