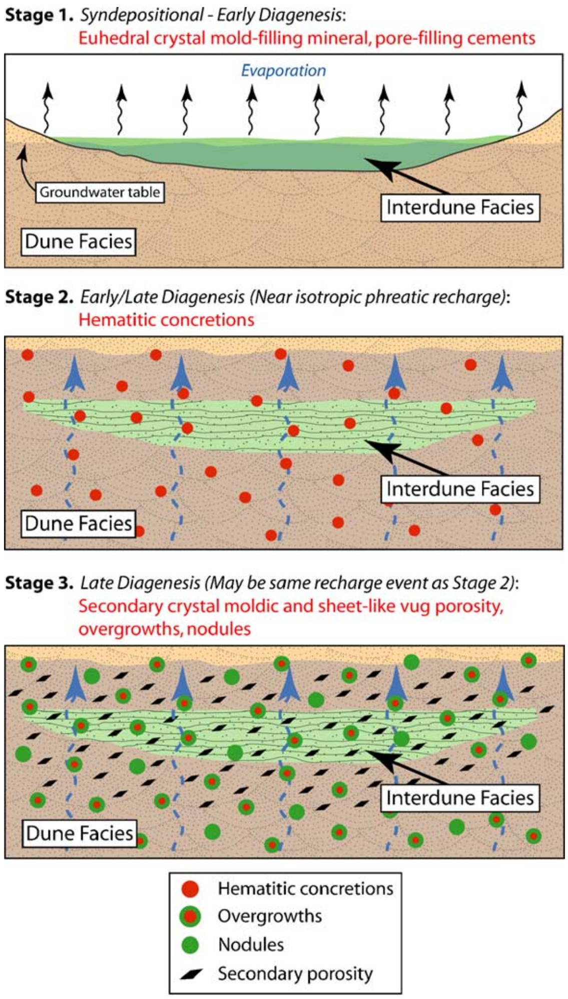

Fig. 14. Schematic model of the diagenetic history in the Burns formation. For simplicity, the sand sheet facies [2] is not represented in this diagram. *Stage 1 - Syndepositional Through Early Diagenesis*. Evaporation of near surface groundwater table or capillary fringe of groundwater table results in intrasediment formation of mm-scale euhedral crystals of highly soluble evaporite mineral. At about the same time, early pore-filling cements form by evaporative processes. *Stage 2 - Early / Late Diagenesis.* Slow recharge of chemically distinct groundwater (higher pH and/or more oxidizing than pre-existing groundwater conditions) results in breakdown of jarosite or other Fe-sulfate (such as melanterite) to form hematitic concretions. This process is likely very rapid and thus marks a convenient boundary between early and late diagenesis. *Stage 3 - Late Diagenesis*. Formation of secondary crystal moldic porosity is due to dissolution of syndepositional mm-scale euhedral evaporite crystals and secondary sheet-like vug porosity due to dissolution of relatively soluble pore-filling cements. Secondary porosity may result from formation of hematitic concretions. Second generation of cements forms as overgrowths on concretions and, lower in the section, as cemented nodules.

Pore-filling cements, likely consisting of Mg-, Fe- and Ca-sulfate ± chloride, crystallized either during or shortly after sedimentation. Cement of this nature may form by at least two mechanisms. The first is by evaporation of near surface groundwater brines (in this case Mg- and Fe-rich) resulting in crystallization of evaporitic minerals, thus implying phreatic or capillary fringe environments [34]. The second mechanism occurs in the vadose zone by dissolution/reprecipitation processes at grain boundaries or by reworking of wind-blown or adhered dust derived from eroded evaporite surface crusts and deposited with the sand [32,64]. Distinguishing phreatic from vadose zone processes requires microtextural information, such as the identification of meniscus or pendant cement textures, and cannot be resolved with available image resolution. Nevertheless, the pervasive character of these earliest pore-filling cements and evidence for complex recrystallization is considered most consistent with phreatic or capillary fringe conditions [34].

Formation of the crystal mold-filling mineral is interpreted to be analogous to the formation of relatively small euhedral halite crystals found in some modern detrital-dominated sabkhas (e.g., [34]). In this setting, halite forms distinctive layers either at the sediment surface or within the sediment itself through evaporation of the capillary fringe of a near-surface groundwater table. Meridiani mold shapes are generally similar to the crystal habit of gypsum [60], which commonly forms gypsum rosettes or "poikilitic" crystals beneath the water table [32,34,62,68,69]. Nevertheless, the crystal mold-forming mineral in the Burns formation is interpreted instead to be a very late stage evaporitic mineral (i.e., at least as soluble as Mg-sulfate), such as melanterite or an Mg-, Fe-, or Ca-chloride. The reason for this interpretation is that the dissolution of the crystal mold-forming mineral to produce secondary porosity (see below) does not appear to have caused any noticeable disruption to the immediately surrounding evaporitic components suggesting that the later dissolving fluid was nearly saturated with all but the most soluble minerals.

6.2. Late diagenesis

The formation of the hematitic concretions provides a useful benchmark separating relatively early from relatively late diagenetic processes. They likely formed very quickly, perhaps explaining their uniform size distribution, and are found pervasively across all facies boundaries. Diagenetic conditions, which are consistent with available mineralogical, geochemical and textural data [25], as well as geochemical modeling [17], are that concretions grew within the phreatic zone during slow recharge (relative to the rate of concretion growth)