1. Gold-catalyzed cyclization are often suggested to proceed through either carboxylation or gold carbene intermediates. The contribution of each mechanism is an area of ongoing discussion.

   a. Alois Fürstner collected the following data. Which mechanism does it support, and why?

   ![Chemical reaction diagram]

   Carbocation, because that explains attack of the oxygen on the more hindered carbon, as well as the improved yield.

   

   ![Chemical reaction diagram]

   R_1=R_2=H
   R_1=Me, R_2=H
   R_1=H, R_2=Me

   11% 80%
   19%
   82%

   b. Dean Toste observed the result below. Does it support or refute the above paradigm, and why?

   ![Chemical reaction diagram]

   Refutes carben in favor of carbene, evidenced by the terminating C-H insertion.


2. Gold catalysis was used, again by Fürstner, in a synthesis of engimazole A.
   a. Provide a plausible mechanism for this key step.

   ![Mechanism Diagram]

   b. If the chirality of this ligand was mismatched with the substrate, the following byproduct was formed, and the yield was substantially reduced. Provide a plausible mechanism for its formation.

   ![Mechanism Diagram]

3. Provide plausible mechanisms for the formation of these three observed products.